JANUARY 16, 1956 50 CENTS

AVIATION WEEK

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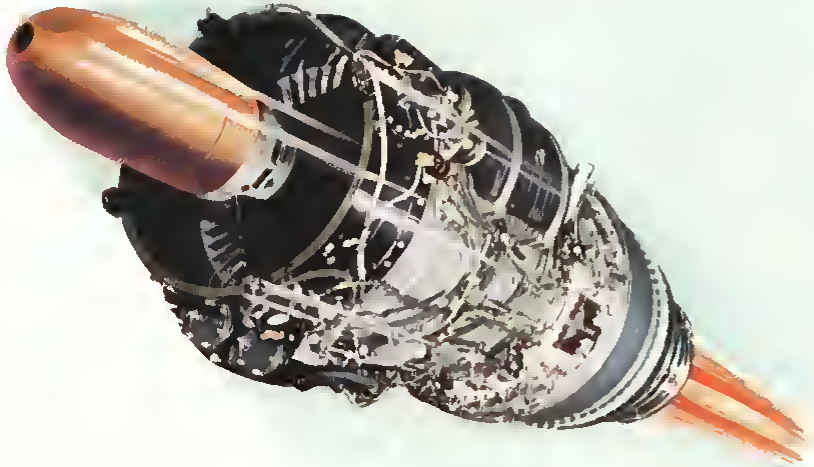
First Details of Ramjet Talos Missile



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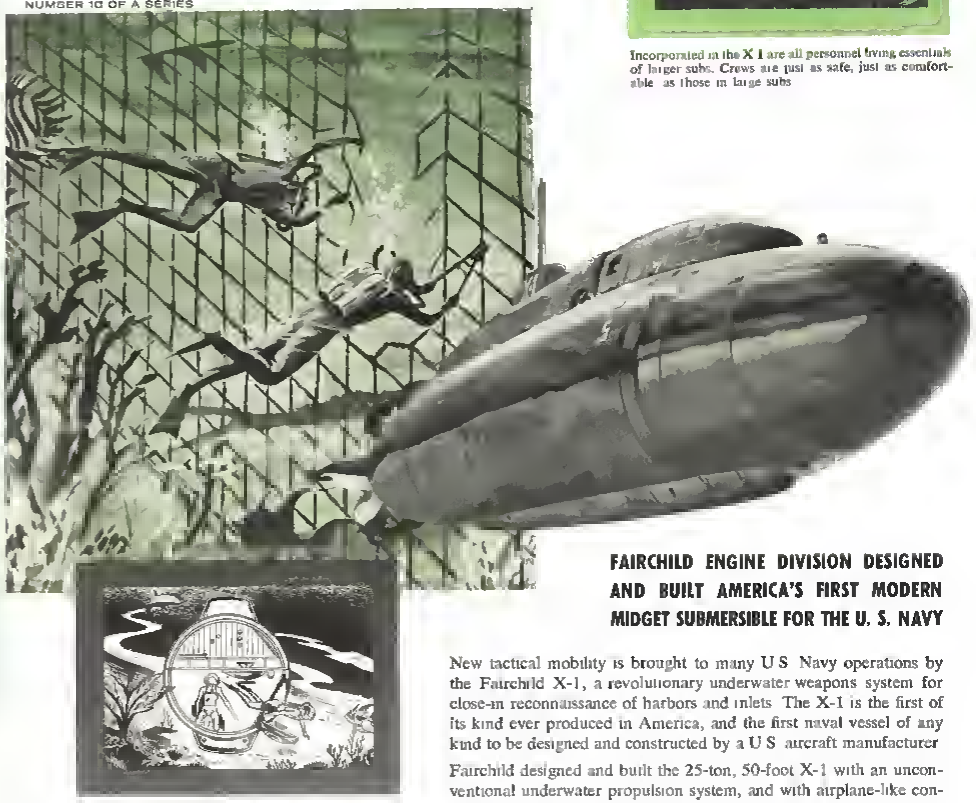

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AVIATION CALENDAR

Jan. 19-21—National Simulation Conference sponsored by Dallas-Fort Worth Chapter of Institute of Radio Engineers Group on Electronic Computers. Dallas, Tex.
Jan. 23-25—Helicopter Association of America, Inc., annual convention, Sheraton Palace Hotel, San Francisco, Calif.
Jan. 23-26—Institute of the Aeronautical Sciences 24th annual meeting, Sheraton Astor Hotel, New York, N. Y. Jan. 23—Honors Night Dinner.
Jan. 23-26—Plant Maintenance & Engineering Show and Conference, Convention Hall, Philadelphia.
Jan. 30-31—Industrial Economics Conference, Statler Hotel, Los Angeles.
Jan. 30-Feb. 3—American Institute of Electrical Engineers, winter general meeting, Hotel Statler, New York, N. Y.
Feb. 2-3—National Symposium on Microwave Techniques, sponsored by Institute of Radio Engineers' Antenna & Propagation Group and Theory & Techniques Group, Philadelphia.
Feb. 7-9—Society of the Plastics Industry 11th annual Reinforced Plastics Div. conference, Chalfonte-Haddon Hall, Atlantic City, N. J.
Feb. 16-17—Transistor Circuits Conference, University of Pennsylvania, Philadelphia. Sponsored by Institute of Radio Engineers, American Institute of Electrical Engineers and Univ. of Pa.
Mar. 19-21—Society of Automotive Engineers national production meeting and forum, Hotel Statler, Cleveland, Ohio.
Mar. 19-22—Institute of Radio Engineers, national convention, Waldorf-Astoria Hotel & Kingsbridge Armory, New York.
Apr. 9-12—Society of Automotive Engineers national aeronautic meeting, aeronautic production forum and aircraft engineering display, Hotel Statler, New York, N. Y.
Apr. 10-11—Symposium for Management on Applications of Analog Computers, sponsored by Midwest Research Institute, University of Kansas City, Kansas City, Mo.
Apr. 18-19—First Annual National Industrial Research Conference, sponsored by Armour Research Foundation of Illinois Institute of Technology, Hotel Sherman, Chicago.

AVIATION WEEK • JANUARY 16, 1956
Vol. 64 No. 3

[illegible] McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y. [illegible]

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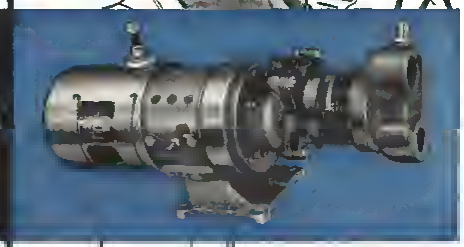

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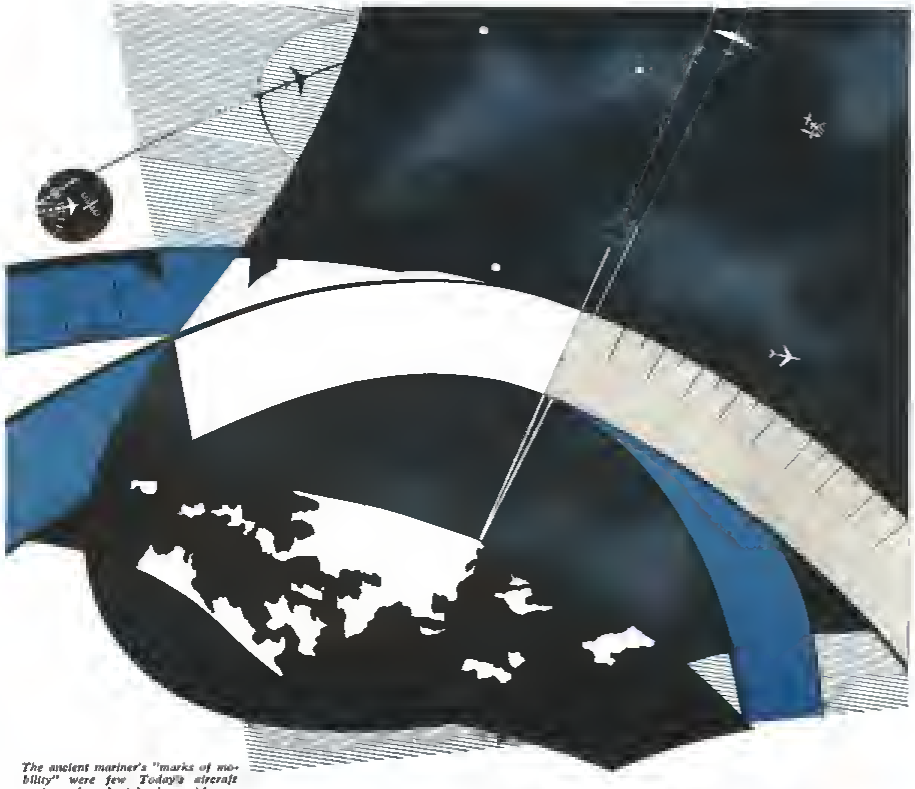

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NEW WEBER BUFFET PROVIDES HOT MEALS FOR MATS PASBENGERS ON C-121C

Military personnel being flown on long hops throughout the world by the Military Air Transport Service will enjoy hot, nourishing meals on Lockheed's new C-121C

One of the fastest military transports in service, the new triple-duty Lockheed Super Constellation uses the Weber buffet on long trips This new C-121C can be quickly converted from a 75-passenger version to either a flying ambulance carrying 47 litter patients plus hospital attendants or to an aerial packhorse toting more than 14 tons of bulk cargo

Powered by four turbo-compound engines, the C-121C has a maximum takeoff weight of 133,000 pounds and is 116½ feet long It cruises at 335 m p h. The Weber buffet was designed for such convertible ships as this it can quickly be installed or removed to meet the specific requirements of the flight

This triple-duty Super Constellation can be quick-switched to cargo, passenger, or hospital litter duty The Weber Buffet and seats are easy to install or remove.

A WAF Airman 1st Class and a Staff Sergeant prepare to serve a test group from the new Weber Buffet. Plant test demonstrations under typical operating conditions were held during the development of the Buffet and Passenger seats to assure maximum convenience and utility

Serves up to 80 with hot meals

Up to 80 passengers can be served hot delicious dinners from the new Weber buffet which has just been developed by Weber in conjunction with MATS, WADC, AMC and Lockheed personnel This new buffet is equipped with frozen food ovens that quickly convert frozen meals to hot ones Variety is provided by a series of 10 different menus A typical serving includes roast turkey with dressing, mashed potatoes, lima beans, salad ice cream and a beverage

Complete kitchen facilities

In addition to the ovens, the buffet has a dry ice refrigerator, hot and cold liquid containers, hot cups, individual serving trays, a portable water system, a sink, complete electrical system, refuse container and miscellaneous storage space The buffet is readily removable and is adaptable to many types of military air transports All working and exposed surfaces are stainless steel with the frame construction of aluminum

Specially designed passenger seats

The Weber passenger seats used in conjunction with the buffet are also removable. Plenty of passenger comfort is offered, yet the seats may be folded against the bulkhead or placed in cargo compartments. Separate serving trays are provided with each seat, as well as space for an exposure suit and a Mae West life jacket Real comfort for passengers is assured with contoured foam rubber construction covered with nylon plus the fact that each seat can be individually reclined

During development of the buffet and seats, WAF personnel served a series of meals under typical operating conditions. On the basis of this testing, modifications were made to provide maximum efficiency and ease of operation This is another example of Weber Aircraft Corporation solving problems of the aircraft industry from initial proposal thru final production

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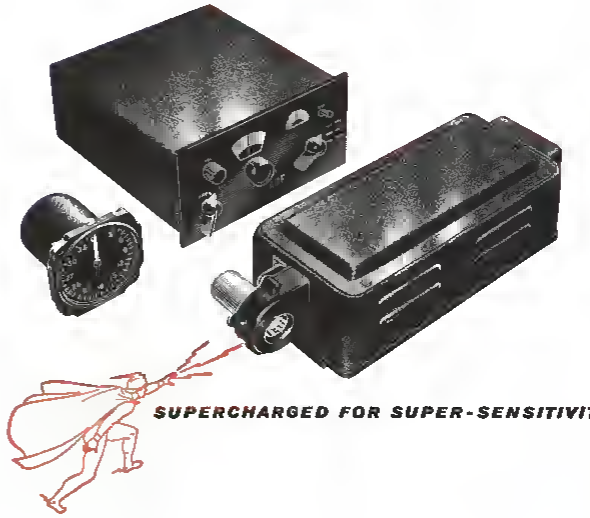

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COVER: Talos missile blasts spectacularly off its firing stand. The Navy's ramjet-propelled anti-aircraft weapon is based on the airframe of the Terrier missile. First published engineering analysis of Talos begins on page 37.

59,991 copies of this issue printed

AVIATION WEEK • JANUARY 16, 1956 • Vol. 64, No. 3
Member ABP and ABC

EDITORIAL

Jet Transport Problems

"We are buying airplanes that haven't yet been fully designed with millions of dollars we don't have and are going to operate them off airports that are too small, in an air traffic control system that is too slow and we must fill them with more passengers than we have ever carried before." This philosophizing by an airline president on the current jet transport procurement program by foreign and domestic airlines is perhaps a little too pessimistic but it does highlight the tremendous problems airline management is shouldering with its entry into the jet era.

The jump of airline management into the jet age is typical of the spirit of aviation pioneers who have never let a tangle of future problems deter them from striking out boldly into the unknown. We are confident that eventually these problems will be solved and that an ever increasing number of people will fly swiftly, smoothly and safely on a jet transport network that will give the once formidable dimensions of the world another significant squeeze. Orders placed for more than a billion dollars worth of gas turbine powered airliners during the past six months make it certain that the jet transport era will arrive in force by 1960.

Before then the pioneering operations of the turboprop powered Vickers Viscount and the Bristol Britannia should give operators a more distinct view of future problems although the use of relatively small quantities of these aircraft will not subject the global transport system to the strain that will be imposed by jet operations in full scale. The turboprop transports also will escape one of the major problems facing the turbojet equipment—noise.

Noise Problem

Noise levels turbojet transports impose on the ground maintenance and servicing crews and the communities around airports will be one of the most serious problems facing the airlines because of the tremendous political pressure it can generate. Airports are run by municipal authorities who are extremely sensitive to local political pressure. There is no generally acceptable technical solution yet to the requirement for reducing turbojet roars to an acceptable whisper, although there is a major technical effort focused on this goal. The entire ground environment of the jet transport poses a multitude of unsolved problems. Even at the early gross weights of the turbojet transports few airports here and abroad could handle them on routine operations. Now with the gross weights rising by the week until some are nudging the 300,000 lb. mark, the airport problem becomes more acute. The commercial airports of all but a few terminals that anticipate jet transport operations face major revision including some re design to accommodate the turbojet giants.

Longer runways, improved landing aids, larger terminal facilities and perhaps a considerably different surface operation technique will be required for jets.

Better Traffic Control

Nobody even remotely familiar with the problem will contend that fleets of jet transports could operate with any degree of schedule regularity in the present air traffic control system. It is already badly strained handling the piston-powered transport traffic of today and will require technical improvement on a major scale to meet the demands of jet transport fleet operations.

Airlines operate to make a profit. If jet transports are to be profitable they will have to be operated at high speeds carrying large passenger loads. A jet transport that cannot be manipulated swiftly over an airline system carrying loads of 100 passengers probably will not contribute much to net income.

Filling the spacious cabins of the jet transports will pose problems for sales, reservations and passenger service that can only be dimly perceived now. For example, unless the airlines lick the no-show problem they may find their jet transport hauling a high percentage of reserved but empty and unpaid for seats. This would be a road to ruin.

Need New Sales

Nor can a reservations system where it often takes 20 minutes to reach a clerk via telephone function fast enough to consistently fill the jet seats.

The hauling capacity of the jet transport fleet with its combination of huge cabins and high speeds will accommodate a higher traffic volume than the airlines now carry. Airline sales will have to snare a larger portion of the travel market to feed the jet cabins and keep revenues well over operating costs.

Although many design details of the big Boeing and Douglas turbojet transports remain to be settled the metal cutting for them will begin soon to meet the 1959-60 delivery dates. Airline managements who have and will order these jet transports will have to begin their system re design now in order to have it functioning smoothly, safely and profitably when the DC 8 and the 707 take to the airways.

—Robert Hotz

WHO'S WHERE

In the Front Office

Lionel R. Fiedler, vice president, American Bosch Arma Corp., formerly vice president sales, Arma Division.

Brian Cooke, vice president-treasurer, Hawaiian Airlines, succeeding David Watson, who resigned due to health. Lambert B. Irons is new secretary.

Richard B. Hubbard, president, Erco Division, ACF Industries, Inc., Riverdale, Md., formerly vice president-chief engineer, Specialties, Inc., Syosset, N. Y.

Rear Adm. Frederick R. Furth, (USN, ret.), special assistant to president Farnsworth Electronics Co., a division of International Telephone & Telegraph Corp. He was formerly Chief of Naval Research.

Rear Adm. Luis de Florez, (USNR), president, Flight Safety Foundation, Inc., New York N. Y., succeeding the late Adm. John Towers.

J. Hanson, deputy chief scientific officer, Structures Department Royal Aircraft Establishment, Farnborough, England. **D. E. Morris,** deputy chief scientific officer and chief superintendent, Aircraft & Aircraft Experimental Establishment, Boscombe Down. **Dr. B. G. Dickens,** director of guided weapons research and development.

Vernon W. Deinzer, vice president-general manager, McCauley Industrial Corp., Dayton, Ohio, formerly vice president-manufacturing.

Lonnie D. Harrison, vice president-treasurer, National Aircraft Corp., Burbank, Calif., formerly secretary-treasurer, Mark Aero Supply, Inc., Washington, D. C.

Raymond E. Wiese, vice president-director, Hunter Manufacturing Corp., Bristol, Pa. **Arthur P. Paine,** manager of the Aircraft Division and assistant secretary, Bristol Engineering Corp., wholly owned subsidiary of Hunter.

Honors and Elections

Nathan I. Hall, vice president, Hughes Aircraft Co., Culver City, Calif., named a Fellow of the Institute of Radio Engineers.

S. Alden Pendleton, controller, Curtiss-Wright Corp.'s Electronics Division, named a member of the Controllers Institute of America. Other new members: **Elmer A. Heunig,** treasurer, Cleveland Pneumatic Tool Co., and **Rolfe Wyer,** plant controller, San Diego Division, Solar Aircraft Co.

Changes

William F. Hafstrom, manager marketing, Government Contracts Division, Stromberg-Carlson, a division of General Dynamics Corp.

James F. Drake, preliminary design chief, Marquardt Aircraft Co.'s Powerplants Engineering Subdivision, Van Nuys, Calif.

Norman L. Winter, general sales manager, Sperry Gyroscope Co., Great Neck, N. Y., formerly federal contracts director of the company.

William M. Duncombe, field engineer and assistant to commercial sales manager, Aircraft Radio Corp., Boonton, N. J.

(Continued on page 74)

INDUSTRY OBSERVER

► Piasecki Helicopter Corp. is working on twin turbine version of the H-21 Work Horse for the Army. Earlier 4-turbine idea, using the French Artouste engine has been abandoned.

► Despite the Comet III's round-the-world proving flight, sales prospects for the Comet IV still appear dim. Most foreign airlines that would be prime Comet IV prospects are buying Boeing or Douglas jet transports. Those who ordered Comet Mark I and Mark IIs are also unhappy about their prospects of settlement with de Havilland.

► On-and-off operation of solid-propellant rocket motors, once the biggest barrier to their general acceptance, has been solved by at least one developer of the units. Secret is to vent the combustion chamber when shutdown is desired. This reduces the combustion chamber pressure below the value necessary to sustain combustion and the charge stops burning.

► British guided missile progress has reached the stage where Royal Air Force technical officers and enlisted men are being assigned to the manufacturing plants for familiarization with the new weapons. The plants include Bristol Aeroplane Co., English Electric, Fairey Aviation, de Havilland, Vickers Armstrongs and Armstrong-Whitworth Aircraft.

► U. S. airline operators who are buying the Boeing 707 and Douglas DC-8 jet transports will use external antennas for their communications equipment rather than the flush antennas used by USAF in the B-47 and B-52 bombers. External antennas will be strung along the top of the cabin from cockpit to tail. Airline operations experts feel the percentage of communication blackouts in military planes resulting from flush antennas is not acceptable for airline operations.

► Navy pilots from Patuxent River have conducted early flight test of the Piasecki HUP-4 at the manufacturer's plant in Morton, Pa. HUP-4 is powered by the Wright R1300 engine, replacing the Continental R975-42 in the HUP-2.

► British observers are wondering how much pressure the Ministry of Supply will bring to bear on brilliant (Canberra and Gnat) designer W. E. W. Petter to leave Folland Aircraft and return to one of the large aircraft firms.

► Boeing-Seattle has received a $400,000 contract from Navy's Bureau of Ships for development work on the 502-1 gas turbine engine.

► Stanley Aviation Corp., Denver, Colo., has been awarded an Air Force contract for the production of F-84F cockpit procedure trainers. The Stanley trainer embodies complete automation of all normal and emergency procedures. The T-33A and RB-66B trainers are in service now. A prototype of the F-84F trainer also is in service.

► Watch for a shakeup in the British helicopter program. Too many projects spread over too little talent and research resources plus unwillingness of some major aircraft firms to push rotary wing developments has put the British helicopter pace a decade behind its U. S. competitors and lost any possibility of international sales. Best bet to emerge strongest from the Ministry of Supply shakeup—Bristol.

► Designations of the Boeing Jetliners are: 707-120 for the model with the J57 engine, 707-220 for the medium heavy with the J75, and 707-320 for the Intercontinental.

► Air Force planes are accumulating flight time at the rate of about 10 million hours a year. Major accident rate is between 15 and 19 per 100,000 hours of flight. USAF jet fighters are flying about 1.5 million hours a year and account for approximately half the major accidents. During the first half of 1955, major accidents to jet fighters occurred at the rate of about two a day.

Washington Roundup

Civil Air Reviews

Two congressional committees plan broad reviews of civil aviation policy.

• **Senate Small Business Committee** is considering a report by Civil Aeronautics Board outlining steps that have been taken since 1952 to increase competition in air transportation. In 1952 the committee blasted the Board for stifling the growth of unscheduled carriers.

• **House Commerce Subcommittee on Aviation**, headed by Rep. Oren Harris (D-Ark.), will open hearings Jan. 17, with testimony by CAB Chairman Ross Rizley. The hearings will be on omnibus legislation rewriting the 1938 CAA Act introduced last session by Harris, but will take the form of briefing sessions.

New ATA Officials

Warren N. Martin, 45, Trans World Airlines official, will become vice president for State Affairs of the Air Transport Assn., one of the two new vice presidencies created by ATA at its board of directors meeting last month (AW Dec. 26, p. 82).

Martin will join ATA Feb. 1 as Director of State Affairs, with the understanding that his election to the $18,000-a-year post at the next directors' meeting in March is assured. An attorney, Martin has been with TWA for 10 years, most recently as regional director of Civil Affairs at Kansas City.

Martin's selection for the vice presidency for State Affairs is expected to be followed shortly by the naming of a vice president for Federal Affairs.

Tronsponder Reluctance

Air Navigation Development Board may be unduly pessimistic over interference problems which recently have come to light in the air traffic control transponder beacon program (AW Jan. 9, p. 23), some observers believe.

They say the interference problems, resulting in part from many civil and military ground interrogators operating in close proximity, can be overcome with available techniques, providing civil and military agencies cooperate.

The ANDB does not want to dampen industry-wide enthusiasm for the much-needed transponders, but it is reluctant to see airlines and avionics industry invest heavily until system tests in the New York area disclose whether known fixes are effective. Informative test results are expected by March.

Airport Problems

Industry and Government officials sought last week to define airport problems involved in operation of commercial jet aircraft. The meeting, first to be held on the subject, left most previous questions unanswered and uncovered many others. The purpose of the gathering was to set out problem areas so that work could be started on their solution, and discussion of the long list of agenda items gives the Civil Aeronautics Administration and other organizations concerned a basing point for further work.

The CAA will consider changing its airport regulations in light of jet problems. The basic factor in future planning for airport operators appears to be that they will have to deal with bigger, faster, heavier aircraft, calling for expansion of present facilities as part of the long-term evolution in air transportation development.

The dispute between airport operators and aircraft manufacturers over yardsticks to be used in designing new transports was a factor in the discussions. Airport officials figure the manufacturers should design aircraft to meet the standards of existing facilities, and the manufacturers say this approach impedes progress and doesn't meet the demands of a growing air market. The airport operators are also wary of jet noise levels. The manufacturers seem sure the noise problem will be surmounted when the jets start operating.

Air Line Pilots Assn. representatives told the meeting that a lot of problems relating to inadequate airport facilities are current, not future considerations. They say facilities need expansion, now, not four years from now when the jets come into use.

Free Ride Policy Out?

Civil Aeronautics Board is expected to drop its plan authorizing free airline rides for designated employes on CAB business. In the face of opposition of Air Transport Assn. and other spokesmen, the Board has put off action on final approval.

Rep. Percy Priest (D-Tenn.), Chairman of the House Commerce Committee, does not think the proposal is "sound" and plans to have his committee review it, if it is put into effect.

Army Is Thankful

Gen. Maxwell D. Taylor, Army Chief of Staff, says he has things to be thankful for in 1955. Among these "is increased understanding of the roles and missions of the Army, that there is less preclusive attention paid to the air-nuclear threat and greater recognition of the dangers of the one short war concept." Questioned on this viewpoint, Gen. Taylor said he has noticed an increasing number of comments in the press, for example, where editors and writers have expressed skepticism about the short war concept. And, he added, the short war concept "is not part of my thinking."

CAA, CAB Appointees

Senate Commerce Committee has put the nominations of G. Joseph Minetti to the Civil Aeronautics Board and Charles J. Lowen as Civil Aeronautics Administrator on the shelf until the subcommittee headed by Sen. Mike Monroney (D-Okla.) completes its investigation of the firing of former CAA administrator Fred B. Lee (see p. 28).

Observers expect senate confirmation, though, in a few weeks.

Minetti, former Commissioner of Marine and Aviation of New York City and now a member of the Maritime Board, would replace Josh Lee, a Democrat whose appointment expired Dec. 31. Lowen, who has been Deputy CAA Administrator since August, formerly was Director of Safety and Excise of Denver and manager of the Denver Airport.

—Washington staff

Air Traffic Control Problem Goes Before President

Bureau of Budget study group recommends creation of cabinet-level post, preparation of 20-year plan.

By Preble Staver

Washington—Dangerous deficiencies of the present air traffic control system require creation of a cabinet level post and preparation of a comprehensive aviation facilities plan for the next 20 years, an Aviation Facilities Study Group recommended last week to Rowland R Hughes Director of the Bureau of the Budget

The action placed the rapidly worsening problem of air traffic control before President Eisenhower

The seven member group, headed by William Barclay Harding, was appointed by Hughes on May 4, 1955 to determine if there should be a study made of the long range requirements for aviation facilities which they defined as including airports navigation aids, traffic control devices and the communications that link them together

Group Recommendations

The group strongly recommended the need of a study and outlined four major areas of inquiry

- **How to make more efficient use** of the national airspace by allocation and traffic control which is safe, efficient, and equitable for all users
- **How to integrate civil and military** expenditures, particularly expenditures for research and development of aviation facilities
- **How the cost of facilities should be** financed from private and public sources
- **What kind of government organization** is required to control use of the airspace and be responsible for the appropriate Federal interest in the construction and use of Government-financed military and civil aviation facilities

Leadership Emphasized

The group issued this strong warning

"Unless some urgent action is taken to provide full time high-level leadership to the problem of bringing our aviation facilities in line with air traffic growth and the progress being made in aircraft development ever more dangerous conditions in the air can be anticipated"

The members further warned that to make the kind of study recommended without placing it under independent central direction at a high Government level would be ineffective and wasteful of manhours and expense

The group's report noted that no cure all is visualized by making a study alone but that "it would be a necessary prelude or accompaniment to an integrated aviation facilities development program which is urgently required in the interest of public safety, military security and the national economy"

The group noted the lack of a top level systems study and master plan which would provide the executive branch and affected agencies of the Government with a firm basis upon which to build a comprehensive legislative and fiscal program for aviation facilities development

The study should be "undertaken within the framework of the executive branch and headed by an individual serving under a temporary appointment in the executive office of the President," the group urged

The report concluded that an individual with a national reputation and a broad understanding of civil and military aviation should be selected because it was found that none of the inter-departmental committees dealing with coordination have any independent executive authority

Numerous Committees

The group reported the existence of more than 75 committees subcommittees, and special working groups involved with aviation facilities matters The report stated "We think it is abundantly clear that, because of their basic structure, they cannot be expected to provide the dynamic leadership required for origination and development of a comprehensive national aviation facilities system"

The lacking essential elements of effective government action included

- **Full time direction**
- **Full disclosure** of departmental information and plans.
- **Closely coordinated budgetary planning and funding**
- **Unified approach to Congress in matters of appropriations.**

"The Harding group's solution is to have an appointment made in such a way that it is clearly the appointee's responsibility, backed by presidential authority, to work through and with existing organizations and avoid duplications of the services which the existing groups are able to provide

Necessity for urgency in attacking the problem of aviation facilities on a long range basis, the report stated is predicated on these facts

- **Much of our airspace** is already overcrowded.
- **Development of airports** navigation aids, and especially our air traffic control system is lagging far behind both aeronautical development and the needs of our mobile population and of our industry
- **Risks of mid-air collisions** have already reached critical proportions.

The collision hazard is becoming greater as the increases in civil and military air traffic outstrip the capabilities of outmoded traffic control facilities, the members noted

The report said, "the deficiency in our air traffic control system is attributable, in part, to the fact that aircraft capabilities and public demand for air transportation have proceeded much faster than anticipated." The cause is attributed "to the lack of general appreciation of the need for a 'systems' approach to our aviation facilities development"

Fail to Use Knowledge

The absence of a systems development concept has resulted in a failure to utilize fully the technical knowledge that is available and to formulate the programs needed to meet the traffic control requirements, according to Harding's group This has left a "piecemeal" approach they claim A further inadequacy recognized is the diffusion of responsibility for meeting the requirements and the complex and often ineffective, procedures for coordination among those having responsibility

The systems approach is defined as the concurrent development of the aviation facilities with the development of the aircraft using them

This is illustrated by the approach of the commercial jet transport which must become an integral part of a transportation system including the airport complex (with adequate approach areas), the airway (with its traffic control, navigation and instrument landing devices), and the associated communications on the ground and in the air

Fiscal and administrative considerations must also be considered in the system development concept as well as the technical aspects, according to the Harding report, including

- **A determination** as to whom is to finance the building of the system, who is to pay for its operation
- **How its operations is to be administered** as well as who is responsible for designing it to serve national and local needs

In the eight months the Aviation Facilities Study Group existed hundreds of experts were consulted This enabled the group to draw several conclusions on present and potential problems Individual members of the group wrote a section of the report on his specialty with all members of the group concurring in his findings

Unanimous Report

T F Walkowicz said, "Future civil and military aircraft will fly much faster, at much higher altitudes, carrying great loads, and they will do this at significantly lower direct operating costs Furthermore vertical rising and steep gradient aircraft will begin in an important way to take their place in the national transportation picture"

Gen Harold Harris, reporting on operating problems, says a net increase of about 30% in the total number of active aircraft can be anticipated in the next 20 years There are about 90,000 active civil and military aircraft in the U S today of which about 58,000 are civil aircraft, he said In addition to the substantial increase in aircraft population, Gen Harris forecast, there will be a simultaneous and greater increase in aircraft movements by virtue of increased speeds and efficiency permitting more miles to be operated per aircraft

Gen Harris said that at present "we are continuing to fly more aircraft faster, higher, and more and more often, with what appears to be a rather casual disregard of the hazards involved" He said the group was told by several industry and government officials, "we are flagrantly defying the law of averages"

Walkowicz, who handled air navigation and traffic control subjects, said the first major factor having an impact on this problem has been the constant under estimation in future planning of aviation's rate of growth and the load it would put on the facilities

Estimates Exceeded

He pointed to CAA's estimate in 1948 predicting airline passenger miles of 9 to 11 5 billion by 1955 and a revision of the figures in 1951 predicting airline passenger-miles reaching 20 billion in 1960 That traffic volume was attained in 1955, five years ahead of schedule, he said

The group agreed, Walkowicz said, that no good purpose would be served in seeking scapegoats CAA's problem was accepted as being limited in capability by low appropriations and by difficulties in obtaining advanced technical information No excuse was made, however, for CAA's past lack of a realistic long range program for the modernization of aviation facilities which was a handicap, Walkowicz said

Walkowicz termed the Defense Department's preoccupation with urgent defense problems as "quite proper" However, he said, it is the group's view that closer cooperation between the responsible agencies in the future could result in a superior system capable of tracking and separating safely and efficiently all air traffic at less cost than would be possible if two proposed systems were installed and operated independently

The development of two parallel but independent projects relating to the control of air movements was criticized

One is CAA's traffic control program already representing an investment of $110 million and the other is the military air defense radar program in which $670 million is invested which could be better coordinated, Walkowicz said

The only result, he said if they do not quickly become a common system, will be a wasteful duplication in time and tax money

He further reported that CAA will spend $370 million for the installation of their own system with about a tenth of the capabilities of the separate semi-automatic system (SAGE) being installed by the military at a total cost of $3 billion

Necessity of including airport planning as an integral part of a national aviation facilities system was stressed in the report

Fred M. Glass, former Director of Aviation for the Port of New York Authority, claimed airport planning has often been primarily based on local considerations which in many instances, are not properly related to the national objectives He said the fact that although civil airports must provide a reserve for military use in time of emergency No single civil airport in the country is capable at the present time, of handling the Air Force's principal long-range bombers at full operational loads on a sustained basis, he reported

The conclusion drawn was that the Federal Government must accept the responsibility for overall planning of a national airport system as part of the national aviation facilities concept and for the programming of such additional funds both direct and supplemental, required for investment in airports in the national interest The primary responsibility for the financing of individual civil airports and their management and planning should remain at the local level, he said

Study Group Members

Here are the members of the Budget Bureau's Aviation Facilities Study Group

William Barclay Harding partner in the investment firm of Smith, Barney and Co., chairman

T. F. Walkowicz, New York consultant.

N. E. Halaby, New York attorney

Dr. George T. Baker, professor of transportation Harvard Graduate School of Business Administration

Fred M Glass senior vice president of the Empire State Building Corp

Gen. Harold R. Harris, president of Aviation Financial Services, Inc

Jerome Lederer director of the Flight Safety Foundation

J. Gordon Bennett, Civil Aeronautics Administration, served as staff assistant

ODM Orders Greater Dispersion

Washington—Office of Defense Mobilization last week ordered the Federal Civil Defense Administration to develop and coordinate programs to reduce the vulnerability of key targets including defense industries, to enemy nuclear attack The plan may change the architecture of future aircraft and missile plans so they could better withstand bombing

The action followed by a week a report of a civilian committee urging that action be taken in face of the growing threat of superhydrogen bombs and intercontinental missiles (AW Jan 9, p. 26).

ODM's new nation-wide dispersal calls on Federal agencies, including the Defense Department, to encourage new facilities to be located so as to reduce risk of damage and be built to resist the effects of modern weapons

In applying the policy, these factors will be considered

- **The most likely targets** and their size
- **Destructive power** of the possible weapons, including radius of the blast and thermal effects
- **Built-in protective features** of the facility
- **Degree of damage** that could be sustained without crippling the facility
- **Economic requirements** for efficient operation of the facility

Under the order, the Commerce Department is told to guide and assist industry in keeping with a general plan to reduce the vulnerability of metropolitan areas.

Lee Hearing Called 'Fishing Expedition'

By Preble Staver

Washington—Prolonged hearings by Sen Mike Monroney's Commerce Aviation Subcommittee investigating the firing of Fred B Lee as Civil Aeronautics Administrator (AW Jan 9, p 30) have been characterized as a political "fishing expedition" by a Republican member of the group

Sen Fred Payne (R Me) challenged the relevancy of the line of questioning being pursued He told Sen Monroney he was willing to 'sit here for weeks, if these things being brought out were relevant"

A week of hearings, with Lee as the principal witness, has been inconclusive The sparring between members of the subcommittee has shown a straight party-line split Democratic members have attacked the Eisenhower Administration The two Republican minority members—Sens Andrew Schoeppel and Payne—solidly supported the Administration's operation of the executive branch of Government.

Sen Monroney's principal targets have been Commerce Secretary Sinclair Weeks and Under Secretary for Transportation Louis Rothschild, whom he describes as a "ground minded clique" The Oklahoma Democrat charges the Commerce officials forced resignation of Lee by Weeks and Rothschild was a "usurpation of presidential prerogatives' He also claims the White House was responsible for the "suppression" of a section of the cabinet level report on transportation because it is "so raw" in its aviation slant

'Veil of Secrecy'

The controversial transportation study was prepared by a committee headed by Secretary Weeks and completed last April It was later used as the basis for proposed legislation submitted to Congress for the purpose of setting railroad rates competitively with other forms of transportation

Sen Monroney says he hopes to "flush out" a copy of the entire report He also wants for the subcommittee's records a number of documents from the Commerce Department which he claims have been 'surrounded by a veil of secrecy" When attempts to negotiate failed, Sen Monroney demanded that Secretary Weeks produce the following documents

- The President's Air Policy Report of April 1954
- The report from the Cabinet Advisory Committee on Transportation Policy.
- Cresap, McCormick & Paget's management survey of CAA along with covering letter made in June 1954
- Fred Lee's comments and analysis of the survey
- Air Coordinating Committee analysis of the survey
- Wallace Clark & Co management on CAA made in 1948
- CAA five year Federal airways program (AW Nov 14, p 141)
- Copies of annual budget limitation instructions issued by Secretary Weeks

Sen Monroney also wants Sherman Adams, presidential assistant, to appear voluntarily to clear up some questions of President Eisenhower's ready acceptance of Lee's resignation by "form" letter Implication made by Sen Monroney is that the President had not been shown both of the letters Lee testified he sent to the attention of the President

'Long Knives'

Lee told Monroney he first learned he was out as CAA Administrator through a call from a Washington newsman who said, "Fred, the boys with the long knives have gotten you" He stressed in his testimony that it was never his intention to request that he be relieved from the top CAA post

Two letters were written to the President, Lee said In one Lee outlined his case for being kept on the job The second was a letter or resignation which Lee said he submitted as a 'demonstration of good faith" in case the President decided that he should quit

Under questioning Lee said he did not feel the President's letter was 'really responsive because I had not intended to resign." While both of the letters were delivered to Adam's office in the White House Lee said he had no way of knowing whether the President saw the two letters

Sen Payne stated he thought the hearings were doing a disservice to Lee as well as to aviation "when we go into the right of the executive branch to run its own operation"

Touch and Go

A quick look at the history of CAA, he said, will show that it has been pretty much touch and go for the Administrator Payne listed the nine administrators and their terms of office since CAA was created He noted the average service has been about two years

Sen Monroney agreed that "we've had a good many turnovers at CAA" He reminded the Republicans that the Eisenhower Administration was preceded by 20 years of Democratic control and added 'We don't mind your imitating our virtues but don't think you should perpetuate our mistakes"

"I, for one," he said 'was very glad when a 10 year man (Lee) was picked"

The subcommittee periodically digressed from the subject of Lee's dismissal, which is a prelude to consideration of a Monroney-sponsored bill to separate CAA from the Commerce Department

Sen Monroney gave particular attention to an order issued in October 1954 by Charles F. Willis, a former White House aide, which was described as a method for distributing lists of job opportunities to Republican congressmen and state officials

Chairman Monroney asked Carlton Hayward, Commerce Department chief of personnel, if he was aware 'that Mr Willis left his job as assistant to the assistant to the President to become assistant to the president of W. R. Grace & Co., which owns a 50% interest in Panagra

Hayward said he did not know what Willis is doing and insisted there had been no case of interference with Commerce employing officers in regard to appointment of qualified persons

Hayward was asked to describe the steps that led up to the appointment of Charles J Lowen, Jr, as CAA deputy administrator Sen Monroney contended the job was railroaded through.

"I want to inquire into the speed with which Mr. Lowen was added to the payroll in a job about which Mr Lee wasn't consulted nor felt that was needed," Sen Monroney said

The idea for a CAA deputy administrator came from Rothschild, according to Hayward He said verbal instructions for seeking Civil Service Commission approval for re-creating a job paying $13,950 a year came through channels from Rothschild to G T Moore, Assistant Secretary for Administration to himself This was around mid April, he said

The first paper completed was a job description form prepared Apr 26 by S A Kemp, CAA assistant administrator and certified to by Fred Lee This same paper, Hayward continued, was forwarded to Civil Service Apr 27

Pending final clearance on the deputy position, a consulting job was set up on May 2 paying $50 a day he said

Sen. Payne interrupted efforts by Sen. Monroney to learn if the same "speed and dispatch" was being exercised to fill the now vacant deputy position since Lowen has been elevated to 'acting" administrator.

Lee Recalled

Sen Payne said he was concerned about an apparent discrepancy in Lee's previous testimony and Hayward's

Lee had testified that he first knew about Lowen's appointment when Rothschild called him on May 2 and said he was sending over "your new deputy" He also had testified that 'there'd been some talk of re-creating the deputy job."

Sen Payne asked that Lee be recalled, in his own best interests, to clarify the situation He said Lee's signature on the Apr 26 document discounts his testimony on the May 2

On his return to the stand Lee explained by making a distinction between the setting up of a job and the actual filling of it He said that in his

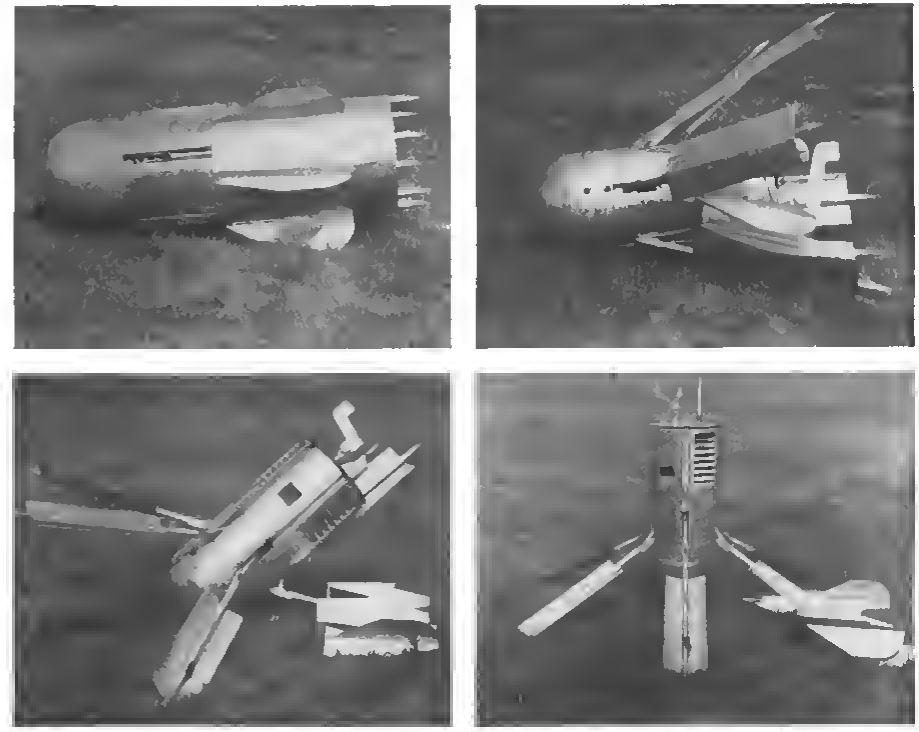
Civil Aeronautics Administration

TOTAL BUDGET REQUESTS AND APPROPRIATIONS
(000 OMITTED)

Fiscal Year	CAA Estimates	Commerce Dept. Recommendations	Budget Bureau Approval	Congressional Appropriation
1950	$123,400	$110,100	$94,000	$94,000
1951	117,900	104,400	104,300	98,500
1952	106,500	106,000	102 800	99,100
1953	111,100	112,400	109,000	105 000
1954	107 000	105,500	105 500	105,000
1955	109,300	100,000	97,300	98,100
1956	117,700	111,700	107,400	106,800

ESTABLISHMENT OF AIR NAVIGATION FACILITIES

1950	$67,800	$67,200	$42,200	$37,500
1951	78,500	46,700	43,500	19,000
1952	39,100	39,100	24 400	10,500
1953	35,500	18,300	15,100	10,000
1954	13,000	7,000	7,000	7,000
1955	21,200	7,700	5,000	5,000
1956	26,500	26,500	23,000	16,000



Robot Weather

"The Grasshopper," a 200 lb robot weather station, will be used in the U. S. Navy's Operation Deep Freeze to the Antarctic Unit, parachuted from aircraft to remote points on the polar icecap will automatically right itself as shown above, take and transmit wind speed and direction, temperature, barometric pressure and humidity Batteries will power robot's radio for 60 days.

reference to the May 2 meeting, when Lowen was introduced as his new deputy, he was talking about filling the position. Lee said that when he heard the job was being re-created, he had hoped one of CAA's career officials would get it.

Lee also told the subcommittee his problems with the Commerce Department on CAA's budget requests in connection with the air traffic control system.

Lee complained that Rothschild had criticized him for not obtaining departmental clearance for the CAA five-year airways improvement program, which was submitted to the Air Coordinating Committee's Air Traffic Control and Navigation Panel. He said the department later cut the proposal for establishment of air navigation facilities in fiscal 1957 from $25 million to $18.5 million.

The latter figure was considered "altogether too low" by the ACC group, which approved the overall program, Lee said. The fact that they approved the CAA long-range plan could be substantiated, he declared.

The subcommittee was told that CAA annually had been estimating the need for new facilities in excess of $40 million. However, Lee said, "We've always asked for less."

Lee testified that Fiscal 1957 was viewed as a critical year and it was felt that the need for improved facilities required immediate planning for a costly long-range program.

A capital investment of $250 million over five years was visualized, he said. This would have been supported by a total budget in excess of $650 million.

Sen. Monroney raised an objection that details of CAA's airway program has not been released. It is one of the documents requested from Commerce Secretary Weeks.

He said the public and press have a right to know the condition of the nation's airways and what improvements are needed. He criticized "leaks" on the plan to the trade papers or favored newsmen who might have stood in well with someone in Commerce.

Sen. Monroney asked Lee to reveal CAA's budget estimates for recent years, "if we can wave aside the veil of secrecy." He wanted complete details, including the amounts ultimately recommended by the Commerce Department.

Sen. Schoeppel settled the question by supplying a seven-year breakdown of CAA's budget estimates, Commerce reductions, Budget Bureau action and final Congressional appropriations (see box). His figures showed continuous budget reductions, in both Republican and Democratic administrations.

USAF Reveals Details on SAGE, Pilotless Interceptor Equipment

Washington—New details on the operation of the SACE (Semi-Automatic Ground Environment) system and its vital role in continental air defense were disclosed here last week by Maj. Gen. James E. Briggs, USAF Assistant Deputy Chief of Staff for Operations.

Speaking before the Second National Symposium on Reliability and Quality Control in Electronics, Gen. Briggs also revealed that:

- **New airborne "gatling gun,"** using several barrels which are rotated at high speed by an external power source, will enable U. S. fighters and bombers to lay down a lot more fire in less time. Although Gen. Briggs did not elaborate, this new gun is believed to be one developed by General Electric which reportedly has a rate of fire of about 6,000 rounds per minute.
- **Pilotless interceptors,** directed to their target and back to base automatically by the SAGE system, may offer competition to one-shot guided missiles. Pilotless interceptors may come into use "when the time arrives that we have faith and confidence in the reliability and accuracy of the equipment and when (its) ability . . . to return to base after air combat to fight again, makes it cheaper than the one-way guided unmanned missile," Gen. Briggs said.
- **Radar data** obtained from early warning aircraft and water-based picket ships may prove incompatible with the automatic computers used in SACE because of motions of the aircraft or ship. Gen. Briggs called this problem "a great field for technological advances."

How SAGE Operates

When the SAGE system goes into operation, all flight plans for both civil and military aircraft, will be fed into large digital computers and automatically stored for future reference, Gen. Briggs said.

When an unknown aircraft is picked up by one of the radars, its track will be transmitted to an associated computer which will instantly search its storage (memory) for a corresponding flight plan.

If the unknown matches the expected position of a known aircraft, within acceptable limits, the computer will reject that track as a friendly aircraft, and that target's blip will "no longer be displayed in the control rooms," Gen. Briggs said.

When an unknown is identified as an enemy aircraft, it is necessary to quickly and accurately calculate what course our own interceptors must fly to bring them within range of their own airborne radar fire control systems. Because a human controller's ability to make such computations is limited, Gen. Briggs said, the same SACE digital computers instantly will make the necessary calculations. The results will be presented to the controller, who will relay the information by voice radio to the interceptor pilots.

Automatic Data Transmission

The next logical step in speeding up this process is to automatically relay such information to the interceptor autopilot directly, by means of "data link." The autopilot will then automatically maneuver the interceptor onto the desired intercept path. Such automatic data transmission "multiplies the capability (of the system) . . . by a large factor," Gen. Briggs noted.

The number of radio and land lines required to interconnect the air defense radars in the Arctic Distant Early Warning (DEW) line, the Mid-Canada (McGill) and the U. S., with associated computers and control centers "are simply tremendous and stagger the imagination," Gen. Briggs said.

"Without techniques of communication and automaticity, we could not afford these projects, or . . . they would probably be beyond our capability to man or maintain them," he added.

Ground-to-air missiles, such as the improved Army Nike, the Navy's Talos, and the USAF's Bomarc, with "ranges comparable to current fighter aircraft," Gen. Briggs said, hold considerable promise for strengthening the nation's air defense.

"When these are available in numbers with sufficient reliability and accuracy, the question arises are they to replace the manned interceptor or are they additive? It appears that for the foreseeable future, range requirements and the need for the human brain on the spot will require the manned interceptor for some time to come," he predicted.

USAF's need for truly long-range interceptors stems from the fact that airfield and missile installation construction costs in the far north run five to seven times those of comparable installations in more temperature climes.

Present thinking is that the U. S. will get more air defense for its dollar by basing five to seven squadrons of long-range interceptors in the U. S., than by basing one squadron in the far north, Gen. Briggs said.

Army Budget Stresses Planes, Missiles

Expanded missile system, strategic and tactical mobility are principle goals, chief of staff says.

By Claude Witze

Washington—U. S. Army made it clear last week, on the eve of its budget presentation to Congress that guided missiles and other aviation projects will receive unprecedented emphasis this year.

- **The Army will spend** "more and more of its money in its continuing effort to expand its guided missile system," according to Gen. Maxwell D. Taylor, Chief of Staff. He added that this includes putting "everything the Army's got" into the joint project with the Navy to develop a 1,500-mile missile.
- **Army's air mobility** program extends "several years into the future," Gen. Taylor said, and "we expect to implement it phase by phase as our financial resources permit." This was assumed to be a reference to the Army's demand for new "aerial vehicles" that must be developed to provide necessary mobility in atomic war (AW Dec. 26, p. 15).
- **Still "hitchhikers"** of our friends of the Air Force" when it comes to long hauls, Army will put efforts in 1956 into extending its strategic mobility. Gen. Taylor denied this means he will seek control of airlift operations, but that an effort will be made to improve operational efficiency.
- **The 101st Airborne Division** will be reorganized to give it greater effectiveness in the atomic battlefield.
- **To meet the Army's need** for improved battlefield air mobility there are critical problems that must be solved. These were defined by Army Secretary Wilber M. Brucker in the areas of power plants, fuels and running gear. He placed particular stress on the need for lighter equipment and tools for highly mobile operations in the Arctic.
- **Army's needs in aviation** will be the keynote at a meeting of its Scientific Advisory Panel, appropriately staged at Ft. Bragg, N. C., Jan. 25 and 26. Ft. Bragg is the home of Army airborne operations and a demonstration of its techniques will open the meeting.

'New Artillery'

Gen. Taylor said the Army needs a "wide span" of guided missiles, which he called a "type of new artillery." He said there has been no determination of who will use and control such weapons as the new medium-range missile, implying that once it is developed it is possible it will go in the Air Force arsenal.

This weapon, he declared, is "something the nation needs" and until we get it the Army and Navy will co-operate simply on the development program. In this, Army will use the men, talents and experience gained from the Redstone missile.

However, he opened a wide horizon for Army missile activity.

"We feel that in Nike we have the beginning of a family of ground-to-air missiles which represent a real hope for an effective element of the air defense of the United States and critical overseas installations.

"These ground-to-ground and ground-to-air missiles will give our forces tremendous destructive firepower ranging far ahead of and above our front lines, that is, high into the enemy air space, and deep into the vital sources of strength of our enemy ground forces."

Gen. Taylor emphasized, in discussing USAF's provision of air lift capacity for the Army, that he was not implying the ground forces should have their own transport plane capability. He also was at no point raising the question of a revision of the 1952 Memorandum of Understanding that limits the weight of Army aircraft.

He said, for example, that some day "we may be interested in jets, but we want to stay within the general puddle jumper classification assigned to Army aviation."

War Deterrent

Both Gen. Taylor and Secretary Brucker, who addressed the Society of Automotive Engineers in Detroit, said the Army shares in the general task of deterring war by its standing strength plus deployments overseas.

Air mobility, Secretary Brucker said, is important to this deterrent power. He called on the Air Force and the aircraft industry to help by procuring and operating more big planes, developing improved types of "aerial vehicles" for Army requirements.

Both men displayed some disagreement with Winston Churchill's thesis that the greatest deterrent to war was American possession of the atomic bomb and the ability to deliver it. Said Gen. Taylor:

Balanced Force

"The first job of the Army is to deter war. To be effective in this war-deterrence, our military programs must be based on reality, it cannot be mere talk, bluff, or threat. . . . It must be balanced so that it is applicable to a variety of possible situations. Balance does not mean equal strength in Army, Navy and Air Force. Balance means flexible, proportioned strength to deter or fight any variety of armed conflict, from jungle or Arctic wars, to atomic wars, or the non-atomic ones of any size."

In the field of air defense, Gen. Taylor also sees the Army in an important role. He said the controversial Nike "is capable of finding and tracking down hostile aircraft with the relentlessness of a bloodhound and with an intelligence almost human."

Army Advisors

"Nike is only the start of a family of missiles which we hope will make our skies so inhospitable as to discourage attack. Progress in missiles is progress in deterrence," he said.

The Army Scientific Advisory Panel meeting to be held at Ft. Bragg later this month is a semi-annual session of scientists, engineers, educators and industrialists. Their purpose is to advise the Army on scientific matters, recommending points where research has progressed to the point where development of military applications is practical.

Speakers at the meeting will include,

Budget Analysis

Next week's issue of Aviation Week will feature an analysis of the military and civil aviation Fiscal 1957 budget requests which were presented to Congress this week.

Complete tables of the appropriation requests and estimated expenditures for Fiscal 1957 will be included.

GEN. MAXWELL D. TAYLOR

in addition to Gen Taylor and Secretary Brucker, Dr James R Killian, president of Massachusetts Institute of Technology, William H Martin, Army director of research and development, and Lt Gen James M Gavin, Army chief of research and development.

Nuclear Reactor Tests Include B-36 Flights

Washington—U S Air Force, ending a month-long silence in the face of wide and inaccurate press reports, has announced officially that a Convair B-36 is flying with an atomic reactor as its cargo.

The announcement made it clear that the reactor is not a propulsion unit and that it is being flown over the Southwest U S as part of an experimental project to develop an airframe to carry a nuclear engine.

Built by Convair's nuclear research and development department, the reactor helps the company study problems involved in having a nuclear engine where it could have an effect on the crew, airframe, instruments and of a new weapons system.

At Convair, the project is headed by Dr Andrew Kalatinsky, once chief of the NEPA (Nuclear Energy for Propulsion of Aircraft) project at Fairchild Engine and Airplane Corp.

USAF said there is no danger of a nuclear explosion if the B-36, 10-engine bomber should crash. Law enforcement officers in Texas, Arizona and New Mexico have been briefed on public safety measures to take "in the unlikely event of an accident."

F-105 Crash Lands

Air Force's F-105 twin-jet fighter bomber, built by Republic Aviation Corp., suffered substantial damage in a recent crash landing at Edwards AFB, Calif.

During a flight test, the uplock in the right main landing gear failed. The gear dropped down into position and was torn off while the aircraft was in a high speed turn. There was no material damage to the plane in flight. The plane was piloted by a Republic test pilot.

In a belly landing on the dry lake the plane's fuselage, left wing tip and stabilizer were damaged. It has been shipped back to the Republic plant at Farmingdale, L. I., for stress analysis tests. The accident took place during a Phase II stability test flight.

The F-105's gear uplock has been completely redesigned and installed on the number two ship, which has been at Edwards since December. The test program will continue. The F-105 is powered by two Allison J-71 engines.

Increase Competitive Bidding, Congress Tells Military Services

Washington—Congressional pressure is forcing the military services to increase competition in procurement by more competitive bid contracting, stricter justification requirements for negotiated contracting and participation by more firms in negotiations.

More than 90% of defense business in recent years has been by negotiated contract. Hearings before the House Armed Services Committee highlighted that all of these negotiations have been justified as necessary because an "emergency" existed—the emergency declared by former President Truman in December 1950, which has never been revoked.

More than 99.5% of the dollar volume of Air Force and Bureau of Aeronautics contracts are negotiated.

The 1947 Military Procurement Act declares competitive bidding the "policy," but lists 17 specific exceptions under which negotiated contracts may be justified. One of these is the existence of a national emergency. Under other exceptions, the secretary of the service is required to approve the negotiated contract and formally justify it in a report to the Congress.

Evasion Charged

Armed Services Committee members protested that the services have not only made the negotiated contract the "rule," instead of the exception, but that they have circumvented the necessity of reports to Congress by standing on the technicality that an "emergency" still exists.

The services contend that reports to the Congress would substantially slow the procurement process.

Defense Department, confronted with the House committee's December report (AW Dec. 26, p. 14), has revoked use of the "emergency" authority for negotiated contracts, effective Jan. 1. But the revocation lists a few specific exceptions and one sweeping exception authorizing the use of the "emergency" provision for any negotiation "determined by the secretary" of the service.

Possible Action

Rep. Carl Vinson (D-Ga.), Chairman of the Armed Services Committee, discounted the revocation and said that it still amounts to government by loophole—the hole is still there, it is just a little harder to see." He points out that under the revocation, the secretaries of Army, Navy and the Air Force could still authorize any contract to be negotiated.

Developments indicated at the House hearings are:

- **Enactment of legislation** conclusively eliminating the "emergency" authority for negotiation of contracts appears certain. A measure introduced by Vinson is pending before his committee, and members of the Senate Small Business Committee plan to sponsor similar legislation in the Senate.
- **Other exemption provisions** of the 1947 Procurement Act will be rewritten.

In some instances, this will be to take care of negotiations that up to now have been justified under the "emergency" authority—for example, contracts to promote the participation of small business in defense procurement and encourage contracts in labor surplus areas.

In other instances, the reporting requirements on negotiations may be reduced. Under the 1947 law, reports must be made to Congress on all research and development contracts negotiated. There is support to exempt the research and development contracts under $100,000.

- **A flat requirement** that 50% of the dollar-volume of defense contracts in each quarter be let by competitive bid has support, but enactment of such a provision is unlikely. The preponderance of feeling seems to be that it would be impossible to administer, and, in addition, might hold back negotiations in guided missiles, aircraft and other key defense procurement.
- **Provision to increase** the number of firms the services invite to participate in negotiated contracts can be expected. House Armed Services Committee members expressed fears that the policy now is to consider only a few "favorite" firms in the letting of negotiated contracts.

Cornell Wind Tunnel Clocked 4,675 Hrs. in '55

Buffalo, N. Y.—The variable density wind tunnel at Cornell Aeronautical Laboratory, Inc., established a new performance record last year with a total of 4,675 test hours, an average of almost 13 hours for each of the 365 days.

The tunnel, now operating three shifts a day, six days a week, is used in the aerodynamic testing of scale models of aircraft and missiles at speeds from subsonic to low supersonic. Almost half of last year's test time, a laboratory spokesman said last week, was in the transonic speed range.

The laboratory is now engaged in a $2 million modernization program.

Defense Policy Reversal Frees Machine Tools for Current Use

Washington—Defense Department has revised its policy on reserve machine tools to permit utilization of the most modern equipment in current production.

Following pressure from the Air Force, where procurement officials disagreed with the policy of putting up-to-date and efficient tools in storage, Defense has given the individual armed forces new power over the tool program.

In a "clarification" of policy, Defense Department said it is seeking to "prevent obsolescence and to achieve flexibility" with these new approaches:

- **Reserve machine tools** will be maintained either in packages owned by the armed forces or in a central Defense Department inventory.
- **The tools in Defense inventory** will be available for use by all departments.
- **Packaged tools** will be reviewed annually to determine their essentiality and possible need for replacement.
- **When industry and the inventory** are unable to provide tools, the armed forces can borrow from equipment in packages.
- **Each military department** will budget for its own tools, including those for current production, mobilization reserves and replacements.

Greater Efficiency

Following an Air Force lead, Defense Department acknowledged that the use of new reserve tools for current production will result in greater efficiency. The policy actually has been followed by USAF to some extent, and its program is believed to have had some influence on the Defense Department and the Office of Defense Mobilization in bringing about the new policy.

The new program on reserve tools is complementary to the recently announced USAF Industrial Production Readiness Policy (AW Jan. 2, p. 18).

Actual significance of the new tool policy is that it marks final scrapping of the so-called Vance plan for maintaining a stockpile. The Vance plan had bogged down with the realization that in many cases it put better tools in storage than were being used for current production.

Short War Concept

Firm USAF viewpoint that an all-out nuclear war would give the country no time to mobilize and get the benefit of industrial production from reserve tools is a key factor.

In a short war, a concept that has increasing Pentagon support, it is believed that USAF would have to fight only with weapons in an operational status.

At best, as defined in the USAF Readiness Policy, manufacturers would be able to deliver only from goods already produced and on hand or on the assembly line.

On Nov. 29, USAF announced that it is ready to obligate $52.9 million for replacement and modernization of tools in use for current production. It was emphasized that the new tools are not for storage.

Reason for Reversal

Evidently convinced of the wisdom of the USAF approach, Defense says it has revised its policy for these reasons:

- To meet changing requirements.
- To insure the availability of modern tools.
- To permit flexibility in the use of new tools and get full benefit from their efficiency.
- To make sure industry personnel is trained in use of modern tools.
- To provide a more realistic basis for determining requirements and budget figures.

Defense stood by the original Vance program but said it was found that it failed to provide for current production and modernization as well as elimination of unnecessary tools from the reserve stockpiles.

On the financial side it was pointed out that the budgets for Fiscal 1955 and 1956 each included $100 million to be allocated by Defense Secretary Charles E. Wilson for long lead-time tools that were to be scaled up and not used for current production.

Budget Picture

About $84 million was returned by USAF as unobligated in Fiscal 1955, which marks the time when their procurement officials decided that the Vance plan was not consistent with the short war concept.

The $100 million set aside for the tool program in Fiscal 1956, the Defense Department said, "is being held in abeyance pending development of final detailed plans concerning its ultimate utilization."

It is expected that Congress will probe plans for use of this money in consideration of budget figures for Fiscal 1957 now on Capitol Hill.

Meanwhile, the Senate Committee on Small Business reported some criticism of Defense's tool program. Said the committee:

- **Defense Department's machine tool inventory** to provide a basis for redistribution on a priority basis in a future emergency, "is far from complete . . . A complete, accurate central inventory of Government-owned machine tools and productive equipment is an imperative prerequisite to sound mobilization policies."
- **Despite the "obsolete character"** of the machine tool inventory, "the Executive Branch is doing little to correct this situation and in a very real sense the government inventory is a wasting asset." The committee protested the recent Defense decision to freeze $70 million in Fiscal 1955 funds for long lead-time machine tools for the Air Force and the $100 million in Fiscal 1956 funds for the three military services.

Navy Seeks $2 Billion For Plane Procurement

Washington—Fiscal 1957 Defense Department budget, submitted to Congress this week, includes a Navy request of $2 billion for aircraft procurement, according to Navy Secretary Charles S. Thomas.

Navy aircraft appropriation for the current fiscal year was $750 million. The Secretary said the amount was low for Fiscal 1956 because of money on hand due to cancellation of some contracts awarded during the Korean war. This was a reference to the McDonnell F3H Demon and one version of the Chance Vought F7U Cutlass and cancellations of turbojet engines.

Secretary Thomas also confirmed previous reports that Navy will seek funds for a small atomic-powered cruiser and indicated the next budget request, for Fiscal 1958, will include plans for the first nuclear-powered aircraft carrier.

He reported "great progress" on the development of an atomic-powered airplane.

ODM Reemphasizes Policy On Three Scarce Metals

Priorities on steel, copper and aluminum for use in the defense and atomic energy programs will be restricted to those specifically authorized by the Office of Defense Mobilization.

In a new order that does not revise current policy, but reemphasizes the curbs on priorities, ODM said there is a current shortage of the three metals in the civilian economy. It was pointed out that the granting of priorities outside of defense and atomic needs could result in unfair treatment of some consumers.

Restriction of Renegotiation Actions Urged by Committee

Washington—Renegotiation should be restricted to guided missile and other highly technical defense contracts which cannot be negotiated with reasonable exactness, the Senate Small Business Committee urged in its annual report.

Even in the small number of dramatic cases,' the committee suggested there are alternative methods of dealing with the problem of excessive profits and raises the question as to whether the cost of renegotiation is justified.

From October 1951, through December 1954 approximately $232 million was returned to the U. S. Treasury as a result of renegotiation proceedings, and the administrative costs of the Renegotiation Board for the period totaled $14 million.

'However, these costs do not reflect the much greater administrative costs borne by the contractor in keeping existing records and accounts, which cost is not only tax deductible but is also passed on to the Government in the price paid for the item or the work which has been contracted for," Small Business Committee pointed out. Estimates fix the costs to the contractor in complying with the requirements of the Renegotiation Board at roughly $175 million. Furthermore, to obtain the true net fiscal picture, from 52 to 80% of the $232 million which the board states it has recouped, must be deducted, as this would probably have accrued to the Government anyway, in the form of corporate taxes on earnings, had not renegotiation claimed it."

Committee Recommendations

As alternatives to renegotiation to control excessive profits on procurements such as 'B-52s, guided missiles, rockets, and other various multi-million-dollar items,' the committee proposed these three methods:

- "A more proper and efficient forecasting and timing of requirements would eliminate many of the so-called emergency situations which so often dot the procurement scene.
- "All negotiated contracts should contain a price redetermination clause which would allow contracting officers to satisfy themselves throughout the performance of the contract that prices and profits were not excessive.
- "[illegible]. Greater use of advertised, competitive bidding by the military services would guarantee more price competition on all procurements and most adequately protect the public interest."

Renegotiation is minimizing the participation of small business in defense business, the committee claimed, because of the Renegotiation Board's policy of allowing prime contractors a smaller percentage of profit on the portion of a contract subcontracted than on work done under his own roof.

Situation Changed

Naturally, whenever possible, the prime contractor will retain work in his own plant even though he might obtain the product cheaper by subcontracting to a smaller business,' the committee commented. 'The damage to both the small subcontractor and also to the Government through higher prices is obvious."

Renegotiation was justified during the early days of the Korean emergency when time was an over-riding factor in defense negotiations, the committee observed, but added that this picture has now materially changed. Today there are hundreds upon hundreds of firms indicating a willingness to compete for all but the most complex defense contracts. Competition, the greatest single deterrent to the danger of exorbitant prices on defense contracts, is hard at work in the economy and has materially lessened the very dangers the Renegotiation Act was designed to combat.'

The four-year lag in renegotiation determinations, it was pointed out, has forced firms to keep reserves which might have gone into expansion.

Other points made in the small business report were:

- While the net value of defense spending increased $3 billion from Fiscal 1954 to Fiscal 1955, the small business man received only 10% of that increase.
- Large business is still receiving the lion's share of progress payments. Although 43.8% of the number of contracts upon which progress payments are outstanding are with small business men, actually only 3.3% of the $28.5 billion of contracts with outstanding progress payments is held by them.

Test Equipment Failure Believed Cause of Piasecki YH-16A Crash

Philadelphia—Piasecki Helicopter Corp.'s YH-16A, world's largest turbine-powered helicopter, has crashed and burned. Two company pilots were killed in the accident.

Indications late last week, with the investigation still incomplete, were that an in-flight failure of test equipment may have started breakup of the huge aircraft.

The test equipment failure, believed to have been in the tail pylon, could have resulted in failure of a prime component. The exact cause and sequence of failures is undergoing further study by the company and U. S. Air Force.

Engineers conducting the investigation have recovered a substantial amount of the instruments and flight recording data with a generous amount of information on the helicopter's performance up to the time of the accident.

The flight was held to determine the aircraft's service ceiling at normal gross weight. Pilots Harold Peterson, Jr., and George Callahan, victims of the crash, took the aircraft to 24,500 ft. This altitude is equal to the world helicopter altitude record held by the Sikorsky turbine-powered XH-39.

The aircraft was put into autorotation and a normal partial power descent was made with the pilot reporting to the Piasecki flight test radio tower at Philadelphia every 1,000 ft. At about 1,800 ft. the pilot reported he was turning full power back on and would start returning the copter to the ramp.

At this point the helicopter broke and fell in three pieces which scattered on both sides of the New Jersey Turnpike near Woodstown, N. J. The forward section burned.

So far, the investigation has turned up no sign of a powerplant malfunction. A company spokesman said Allison representatives were assisting in the study of the wreckage of the two YT38-A-3 turbine engines.

Investigation has included questioning of about 20 witnesses, analysis of the wreckage and study of instruments and film recovered. Observers in a fixed-wing chase plane that had been accompanying the helicopter were of little help because the plane was turning away at the instant of the accident.

Don R. Berlin, president of Piasecki, said the accident in no way alters the company's belief that the YH-16A is a sound project. Work will continue on the original YH-16, first powered by two R2180 piston engines. This aircraft now is being changed to a turbine-powered version with two Allison T56 engines. They have more horsepower than the T38. It will be designated the YH-16B and will be a prototype of the production version.

The wrecked aircraft made its first flight last July and had flown about 32 hours. It had been through much of its test program and claimed an unofficial helicopter speed record of 166 mph.

RAMJET-PROPELLED Talos (left) blasts away from firing stand. Its layout is like that of the Terrier shown on launcher at right.

Talos Integrates Terrier Frame, Ramjet

By David A. Anderton

The Talos ramjet-propelled missile designed for naval anti-aircraft use is the integrated result of two successful developments originating in the Bumblebee missile program sponsored by the Navy's Bureau of Ordnance.

- A supersonic ramjet engine designed for speeds above Mach 2 and controlled in its flight path by a highly developed fuel system.
- A supersonic beam-rider missile, the Terrier, now entering service with the Atlantic fleet as a main battery on the converted guided missile cruiser, the USS Boston.

Talos is now in production with Bendix Aviation Corp.'s missile division as prime contractor and McDonnell Aircraft Corp. building the airframe. Internal guidance equipment is being built by the Farnsworth division of International Telephone & Telegraph.

A land-based version of Talos is under development with the Radio Corp. of America prime contractor for the specific application of the Talos system to defense of land targets.

Talos Layout

Basic configuration of Talos resembles that of Terrier from which it was derived. Diameter of Talos is larger, resulting from the design choice of an integral ramjet powerplant rather than the podded type used later by Boeing on its Bomarc interceptor missile.

A set of four trapezoidal wings arranged in a cruciform pattern around the body provide both lift and control forces. Fixed tail surfaces, modified from a delta shape, provide stability in flight and mount antennas or flares for tracking.

A single booster rocket accelerates Talos to a speed where its ramjet engine will operate.

The Talos ramjet engine uses a central conical body and an annular cowled inlet. Presence of the central spike forces a diagonal shock wave in supersonic flow that reduces the Mach number at the cowl inlet, which is behind the shock. The geometry of the central body also defines the downstream expansion of the subsonic diffuser portion of the ramjet and probably mounts the flameholder at the entrance to the combustion chamber and to the upstream fuel nozzles.

Guidance and control equipment, fuel and warhead are located in the annular structure surrounding the forward portion of the ramjet and in the central body.

The advanced Talos configuration shown on the cover picture does not have the latest engine, although the aerodynamic layout is correct.

Talos History

Talos owes its origin to the Japanese kamikaze bombers of the closing days of World War 2. It was obvious then that conventional anti-aircraft artillery

BUMBLEBEE'S FIRST 18 inch ramjet, a forerunner of the Talos powerplant, made its initial flight in 1946. Burning kerosene, the ramjet attained speeds exceeding Mach 2.

BUMBLEBEE ramjet flight tests began in 1954 with six inch units like two above

was out as a defense against this kind of attack.

In November 1944, the Bumblebee project was formed at Johns Hopkins University's Applied Physics Laboratory, with a general objective of studying research and development on guided missiles. First specific goal of the Bumblebee project was the development of ramjet-propelled supersonic missiles fitted with practical guidance systems.

First task was to develop free flight and ground facilities for ramjets and test vehicles. Late in 1944, a one-inch burner test rig was operated, and by May 1945, full scale simulated flight was possible in a six inch test chamber.

Flight testing began in 1945 with the firing of non burning ("cold") ramjet models to study drag, stability and control. In October 1945, the first experimental verification of ramjet acceleration in supersonic flight was demonstrated by a Bumblebee test vehicle of six inch diameter.

First Big Ramjet

By the end of 1946, Bumblebee's first 18-in. ramjet test vehicle was successfully launched. It burned kerosene, functioned smoothly and accelerated to a speed exceeding Mach 2.

These tests were low altitude runs and demonstrated ramjet feasibility more than any other particular parameter. Over the long months to follow, APL scientists and technicians refined and improved the test vehicles to better

their altitude performance and their fuel control systems.

Meantime, one of the Bumblebee test vehicles, a rocket propelled airframe used to develop stability and control parameters, was taken off test status and further refined as an interim missile to be called Terrier. This vehicle and its beam rider guidance system were available before the scheduled date for a complete Talos system and subsequently branched off from the Bumblebee program to become a missile system in its own right.

The ramjet engine development progressed to the point where it could also be called successful, and the final step was taken. The successful ramjet engine was integrated into the successful airframe and guidance system, and the Talos was born.

During the years, more than 20 organizations have made specific contributions to the Bumblebee program. In connection with the propulsion phase of that work, these groups have made noteworthy contributions: University of Virginia, University of Wisconsin, Princeton University, University of Texas, Esso Research and Engineering Co. (whose relation with the ramjet work at an early stage resulted in at least one Bumblebee vehicle being renamed the EssoBee), Convair Division of General Dynamics Corp., Bendix Aviation Corp., Experiment, Inc. and McDonnell Aircraft Corp.

Arma Walkout Ends With New Agreements

American Bosch Arma Corp. has signed three year contracts with its three unions, settling a three month old strike. Under the agreements, the Engineers Association of Arma received a 2½% per year boost, while the factory and clerical workers' unions (IUE AFL-CIO) obtained an increase of five cents per hour per year. The engineers union held out for more than a month after agreement was reached with the IUE, battling over contract revisions which Arma sought, some of which it reportedly won. (AW Oct. 24, 1955, p. 7)

Curtiss-Wright Acquires Propulsion Research

Propulsion Research Corp., Santa Monica, Calif., has been acquired by Curtiss-Wright Corp.

Propulsion Research, which will continue to function as an independent corporation, is engaged in the research, design, testing and project management of primary propulsion units and in the design, development and production of accessory equipment. (AW Nov. 14, 1955, p. 49)

Operations Knowledge Keys Safe Design

By Ralph H. Miner*

Two-thirds of the task of aircraft accident prevention lies within the responsibilities of the design engineers.

The most prodigious effort by operational personnel can yield at best only a one-third reduction in aircraft accidents.

What is needed is a higher level of air-operations consciousness among aeronautical engineers. This may best be accomplished by an organic change in the base now used for engineering decisions.

The scheduled airlines are considered by insurance houses as normal risk, with premiums comparable to all other forms of transportation. After several years within their present 200 to 400 knot performance regime, the scheduled airlines have achieved operational stability—that comfortable point at which casual, steady state refinement can take place—as evidenced in the safety record of the commercial scheduled airlines.

On the other hand, since January 1954, several thousand serious accidents have been experienced by our military air services. It would not be proper to compare the military accident picture with the commercial accident picture.

The Accident Picture

In connection with the military's current 500 to 700 knot performance regime, the accident picture shows that operational stability has not yet been obtained. This operational stability will be attained, but a serious concern is that production plans for the inhabited aircraft of the next era—those in the 700 to 1,000 knot regime—are proceeding without a current background of operational stability. This is a significant point in considering the design engineering organization.

In missile activities, it is difficult to compare "gross accident picture" with "performance regime." However, a couple of general observations should be sufficient.

The missile business is fraught with a dual frustration. We are not only attempting a quantum jump to an extreme performance regime with all the inherent material difficulties implied in this, but we are flying these machines with an absolute requirement that everything be right before it leaves the ground. There are many misadventures in surface launched guided missile operations. But the inordinate apprehension, both of malfunction and of the tremendous forces involved in reaching for extremes in performance, has netted a nearly perfect safety record.

If the aeronautical engineer can learn to do his job without a catch-all human pilot to lean on, we may well engender engineering disciplines that will be instrumental in realigning engineering policies in the inhabited aircraft field. In any case, operational stability in the missile business is still far down the road.

Forward and Backward

In short, the state of aeronautics as a whole reveals that a phenomenal growth in performance can be contrasted with a steady retrogression in operational stability.

This growing instability in the operational arena is a direct function of insufficient air operations consciousness in aeronautical engineering.

From the earliest days of powered flight up to the early years of World War II, the man in the operational arena—the pilot, the flight crewman, the ground crewman—was considered by the design engineer to be an inexhaustible reservoir of operational ingenuity and integrating skill. And at the time he was just that. The operational man readily endorsed the engineer's viewpoint, for the operator was well within his potential capability. The engineer would ask him to go higher and faster, watch a few more dials, push and pull a few more handles.

The same held in the ground-support phase of air operation. The ground-support crewman's problems were not great. Tools, maintenance equipment and checkout equipment were straightforward adaptations of readily available materiel. Internal density of the aircraft was quite low and readily attended even by subskilled support personnel.

Higher Performance

Year after year the engineer worked for higher performance, tossing uncorrelated operational considerations on the shoulders of the operational people.

Unfortunately, this innocently established working relationship between engineering and operations gradually became a deeply rooted engineering precedent.

These were the "airworthiness" years, so to speak, with man reconciling a powered machine to a new medium. These were the years in which the airplane's needs for greater performance, for greater structural integrity, for greater aerodynamic efficiency legitimately exceeded the needs of those who operated them.

This gave premature birth to a new technology. Career areas were charted, a giant new industry launched, university aeronautical engineering courses established. But all this was done with no operationally oriented conceptual effort.

In short, we are enduring an aeronautical technology which is conceptually incomplete, a technology which is desperately in need of orientation from an operational point of view.

Corrective Measures

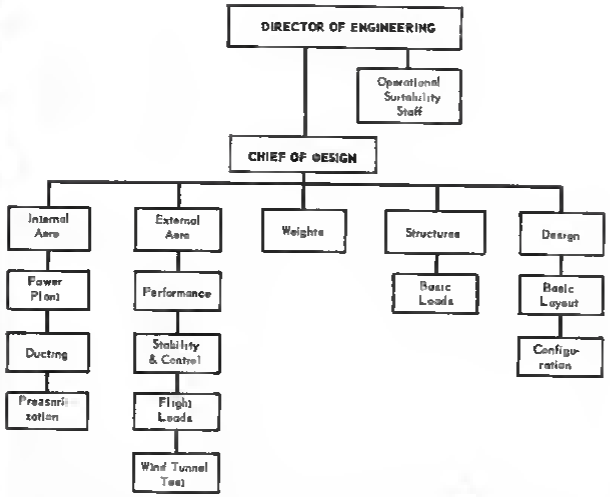
Corrective measures must be aimed toward attaining operational stability without a sacrifice in performance. We can embrace any performance regime, but we will have to pay something to achieve both performance regime and operational stability. This price will be both in time and in the temporary disturbance associated with appropriate policy realignment. An incisive policy realignment could reduce the time loss to a point where it would appear insignificant in the light of increased effectiveness.

The directive force in design engineering must be air operations consciousness rather than performance consciousness.

To begin with, an Operational Suitability Staff would be established re-

Ralph H. Miner, author of this article beginning on this page, has headed the staff engineering of Lockheed Aircraft Corp.'s Missile Systems Division since March, 1954. He also has been associated with North American Aviation, Inc., Northrop Aircraft, Inc. and Marquardt Aircraft Co.

* *Head, Staff Engineering Missile Systems Division, Lockheed Aircraft Corp.*



REORGANIZATION of engineering departments suggested by Miner incorporates an Operational Suitability Staff that would help design accident prevention into aircraft

porting to the Director of Engineering. Initially, this office would have both staff and line authority and would serve the Director of Engineering as a device for maintaining full cognizance of all operational considerations that should influence the design.

This does not suggest any immediate modification of the remainder of the organization. Classical functions such as aerodynamics, structures, propulsion, electronics, systems analysis and engineering test remain unchanged. But none of these groups may move toward problem resolution without authoritative monitoring by the Director of Engineering's Operational Suitability Staff.

The Operational Suitability Staff would be manned by senior engineers and scientists who have placed their classical technical background in a subservient role. They would have skills acquired in actual military operation of all types of inhabited aircraft and guided missiles as well as in military operations research.

Some of the specific skills from these two broad areas would be intelligence, reconnaissance, defense, tactical air, strategic air and training, logistics, crew systems and human factors, communications, air traffic control, navigation, meteorology, geophysics, ground support equipment, statistics, economics and social sciences.

The major job of the Operational Suitability Staff is to insure that each act of design takes place in an "Operational Engineering Laboratory" and to insure that all designs reflect due consideration of operational time and motion limitations.

Time and motion in the user's operational environment are the missing conceptual link in nurturing our aeronautical technology.

Design Approach

An engineer is going to design a prototype of a new 1,000 knot all weather interceptor—an interceptor which will operate in the total weapon system environment as modeled in the Operational Engineering Laboratory. The engineer will have all the assistance he needs but this assistance will be stretch air-operations oriented. All major design decisions—and most of the detail decisions, for that matter—will be impersonally referred by time and motion in the operational environment.

First from his many years of experience and design judgment the engineer drafts a qualitative sketch of the geometry of the over-all airplane. His first sketch is a rough hewn version of an all weather interceptor that will approximate the required performance. Traditionally, the aerodynamics department now would shave the rough hewn airplane down to a sleek, maximum performance envelope. But the requirement calls for operational suitability just as much as performance; and you cannot have both if aerodynamic refinement occurs early in design.

Drawing on the skills in the Operational Suitability Staff and utilizing the facilities of the Operational Engineering Laboratory, the engineer will, in effect, fly his rough design by making a time and motion schedule for each succeeding design refinement.

One of the design parameters the engineer must have in the back of his mind all the way through the design effort is aerodynamic stability. Top performance and operationally suitable aerodynamic stability are not always compatible. Therefore the first time and motion effort will be aimed at determining an appropriate aerodynamic stability parameter.

Since this is the engineer's first departure from a traditional design approach, the Operational Suitability Staff will first guide him in contrasting the company's experimental test environment with the military user's operational environment. Since the time and motion factor has never been critical in the company's flight environment, this comparison will give the engineer a feel for the scope of time and motion as a prime design factor.

Flight Comparison

To begin with, the company's experimental test pilot has a flight scramble time of anywhere from three hours to three days,—the military pilot has a flight scramble time of only three minutes.

The company pilot taxis out singly with lots of time and plenty of room for lateral motion on the taxiways,—the military pilot taxis out with other fighters, hurriedly, with little time and highly restricted lateral motion on the taxiways.

The company pilot swings on to a seven-mile runway after spending lots of time getting ready for takeoff; ceiling and visibility are unlimited and the sun is shining brightly. The military pilot is cleared with virtually no readiness time onto a one-mile runway; ceiling is 500 feet, visibility one mile with light rain and it is night.

The company pilot, with a physical dexterity and mental facility born of several thousand flying hours, leisurely takes off into the bright sunshine, the military pilot, often with only a few hundred hours of experience, charges off into the night and, with no time for contemplation, is immediately engulfed in the overcast.

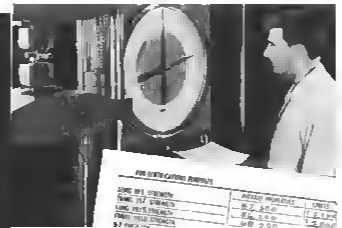
The company pilot is at 10,000 ft. with seven miles of runway in plain sight over his left shoulder. Suddenly he realizes the tip tanks are not feeding. He will have to abort the flight. He makes a leisurely pass over the field,

Bumblebee Profile

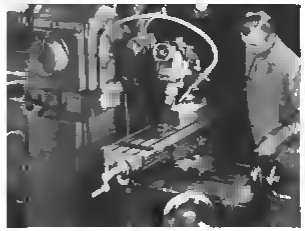
Studies of wing body interference at Mach 2 flow are aided by pictures such as this schlieren photo of a typical model in Navy Bureau of Ordnance's Bumblebee program. The photo shows the shocks and turbulence caused by the four cruciform wings at 45-degree roll attitude. From the picture apparently the wings are at about 10 degrees incidence. Four separate organizations have a hand in this phase of the Bumblebee project. Johns Hopkins' Applied Physics Laboratory, which has the overall Bumblebee responsibility, Cornell Aeronautical Laboratory, which is running this study, BuOrd, which is paying for the Bumblebee project and owns the Dangerfield, Tex., wind tunnel where the tests are being conducted, and Convair, which operates the tunnel for the Navy.

1956: BIG YEAR FOR TITANIUM

Chart of Mallory-Sharon shipments shows titanium progress from development status to major usage in a few years. Prices have steadily declined.

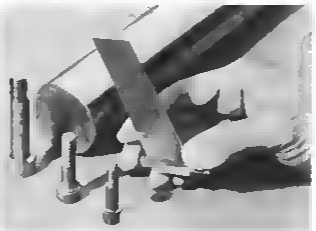


CERTIFIED QUALITY—Using statistical quality control, Mallory Sharon now certifies physical properties of unalloyed titanium within narrow ranges. This enables fabricators to eliminate segregation of incoming material, and avoid multiple tooling setups.



EASIER MACHINING—Improvements in the chemistry of the metal now permit it to be machined as readily as stainless steel. Mallory-Sharon guarantees a maximum of 0.1% carbon—the bugaboo element that causes machining difficulty if present in higher proportions.

STEPPED-UP RESEARCH—This test, part of a Government sponsored project, typifies Mallory Sharon's pioneering in titanium. Research has yielded improvements which permit forming or machining alloys in a ductile condition, subsequently heat treating to high strengths.



NEW HIGH TEMPERATURE ALLOY—New MST Titanium-6% Aluminum 4% Vanadium alloy is a tough material that retains strength at high temperatures. It can be used up to 750°F with minimum change of properties. Alloy was first commercially produced by Mallory Sharon.

INGOT INVENTORY—Delivery time has been cut by Mallory-Sharon's ingot inventory in certain grades and analyses. Here orders can be started at the ingot stage, saving time for fabricators. More standardization in future will further streamline production.

INDUSTRIAL APPLICATIONS—Phenomenal corrosion resistance of titanium, plus its lightness and strength, make it an attractive metal for industry. Hundreds of companies are now using or investigating titanium in valves, piping, processing equipment, marine parts, etc.

MALLORY-SHARON reports major developments as the new metal moves up

The past year has seen a "breakthrough" in the technology of titanium. Quality and dependability have been raised to high levels. Improvements have come so fast that prime quality metal shipped only a year ago would not pass the specifications today's titanium meets.

Thus in 1956 major aircraft and jet engine programs are committed to titanium in large quantities. It's a prime necessity in building superior air power, since full usage of titanium means weight savings of hundreds of pounds per plane. Likewise, industrial applications of corrosion-resistant titanium are expanding. The effort now will be in increasing output fast enough to meet demand.

We plan to double capacity in 1956, and this expansion program is already underway. Both in quality of metal and in service we are anticipating requirements.

Mallory-Sharon titanium and titanium alloys have won enthusiastic acceptance for high quality. We supply virtually every major aircraft and engine builder, and hundreds of subcontracting companies. Call us now for advance planning of your requirements for titanium and titanium alloy sheet, strip, rod, bar, plate, and other mill products.

MALLORY-SHARON INTEGRATES TITANIUM MELTING AND MILL PRODUCTION

Effective January 1, 1956 Mallory-Sharon purchased the Niles Rolling Mill, formerly a division of Sharon Steel Corporation. The mill will produce both titanium and steel products.

Acquisition of the rolling mill integrates titanium melting and mill processing under Mallory-Sharon management, at one location. Thus Mallory-Sharon directly controls titanium production from sponge blending through shipment of finished sheets, strip, and other mill products, facilitating smooth scheduling and uniform quality control.

Mallory-Sharon headquarters at Niles, Ohio, includes the Titanium Laboratory, melting plant, and extensive rolling and fabricating facilities.

MALLORY Ti SHARON

MALLORY-SHARON TITANIUM CORPORATION • NILES, OHIO

with a wide sweeping pattern; "No use crowding the pattern," he thinks. "While this thing goes like hell, it's not necessarily a delightfully stable thing with landing gear, fairing doors, and stuff hanging out the bottom. Better not let too much time go by on gear extension either—that aft retracting nose gear is a little slow on extension."

So with a long, straight-in approach and plenty of speed to work with, a casual landing is made half-a-mile down a dry, seven-mile runway. This is a flight in the company's test environment.

Military Problem

In contrast, look at the military pilot. He has just broken out on top at 10,000 feet, the moon is shining brightly and he has drawn a deep breath of relief, for he plans to use a clear weather alternate base after he completes his mission. He suddenly realizes his tip tanks are not feeding, and the mission will have to be aborted. The military pilot will now be asked to do more things per minute than he is consistently able to do, and he is flying only a subsonic jet fighter.

Since he is aborting the flight under night-instrument conditions, his first step is to continue his climb-out on a predetermined course. He contacts the tower, reports conditions, and requests landing instructions. He then handles the following sequence of events. He contacts Approach Control, assimilates instructions, requests Ground Controlled Approach, intercepts outbound track and turns to inbound heading. He levels off at 20,000 feet, trims aircraft, reduces power. He turns left 90 deg., rolls into 270 deg. right turn and intercepts inbound track.

At marker, he applies 60% power, contacts Approach Control and assimilates further instructions. He extends dive flaps, at 180 knots, he puts wheels down, puts flaps down and establishes 160 knot descent. At 10,000 feet he starts 180 deg. turn, contacts Approach Control and assimilates instructions. He contacts Traffic Controller and assimilates further instructions. He puts gear up, flaps up at 1,000 feet above desired altitude, dive flaps in at 200 feet above desired altitude. He levels off, adds power, intercepts inbound heading, turns to heading given by Traffic Controller.

He turns downwind, executes pre-landing check: gear down, part flaps, green lights, pressure up. He turns onto base, contacts Final Controller, lets down 500 feet. He turns onto final, adjusts to descent speed, receives final instructions. At glide path, he reduces power, drops nose, makes corrections in glide slope, makes corrections in azimuth.

On sighting the field, he turns on landing lights, extends full flaps, extends dive flaps, establishes sink rate, rounds off late, touches down hard and stops gingerly on the far end of the wet runway. This time he made it. Fortunately, he got away with several errors which occur as natural by-products of a "time saturated" operational environment.

In the brief period of time allotted for these 50 events, the military pilot will have checked his instruments at a rate of nearly 200 per minute. In the presence of rain, air turbulence and darkness, he will have interpreted these readings and applied control forces for definite corrections in flight path and attitude at a rate of about 50 per minute. He will have responded to, activated or concerned himself with over 200 cockpit instruments, indicators, levers and switches.

At the point he stops his aircraft and clears the runway, he will have made more than 1,000 major and minor decisions and 2,000 lever, switch and control actuations or deflections, all compacted within an uninterruptable segment of time, at night and in weather.

Why Accidents Happen

Following this comparison of company flight environment and military flight environment, the engineer is now conditioned to talk about the 3,000 military air force accidents that resulted from unsafe acts of pilots. He is advised that these 3,000 accidents occurred only since January 1954 and that most of these accidents occurred under conditions far less difficult than those just discussed.

The engineer is particularly impressed with the fact that among the cause factors the highest percentage of accidents occurred as a result of incomplete piloting in the landing pattern, a result of time saturation. The design engineer is now asking operational questions. He wants to know why emphasis was placed on "night" and "weather" in the comparison of operating environments.

The Operational Suitability Staff points out that each act performed by the pilot at night requires an extra increment of time. If low ceilings and rain or snow are present, another increment of time is added for each act, because night and weather factors induce a significant perceptual lag in the human perception-response time sequence.

While these extra increments of operational time are often in seconds and micro-seconds, the flight-environment discussion shows that these

Comet 2 'Flies' Under Water

Fatigue life of a Comet 2 fuselage is being determined under water in this divided test tank at the de Havilland works in Hatfield. The short section at the front of the tank, shown empty of water, will be used to check components of the Comet 4. Three types of loads are applied during the test cycle: fuselage pressurizing, vertical tail gusts and vertical wing loads with gusts superimposed on steady flight conditions. A typical test cycle lasts four minutes and simulates a three-hour flight; during the "flight," the cumulative effect of gusts has been estimated to be the equivalent of 24 gusts of 10 ft. per sec. Test cycle starts with steady flight loads which lift the aircraft off its supports. Later loadings include 10 gusts with fuselage unpressurized to simulate takeoff and initial climb; four gusts during pressure buildup to the differential for normal climb, four gusts at full pressure differential simulating high altitude cruise; six gusts during pressure reduction to zero, simulating descent.

time increments are cumulative at a terrific rate.

In short, the military pilot must have at his disposal, among many things a degree of inherent aircraft stability that will see him through a staggering burden of operational decision and execution.

The designer now introduces in his hypothetical design a degree of inherent stability that will reduce the portion of precious operational time needed for preservation of flight equilibrium. The engineer now is beginning to understand the absoluteness of time and motion in the operational environment.

He begins to appreciate time as a solid, so to speak, an operational time block capable of containing only a limited number of orderly events. In designing to a higher performance regime, the analogy of time as a solid tells the engineer that significant increases in rate of climb and speed actually seek to compress the operational time block.

The operational time block cannot be compressed, it can only be relieved. Since current design practices are without operational time and motion control, each succeeding generation of higher performance aircraft imposes upon the military pilot more things to do and less time to do them.

Go a step further in the study of "operational time" versus "aerodynamic stability" and it becomes clear that each increase in performance regime carries with it an engineering obligation for an increase in inherent aerodynamic stability.

By now, an operationally suitable level of inherent stability has been designed into the aircraft, that stability can be introduced only during the conceptual phase of design. Such a level of stability would not be obtained if it were introduced as a result of Air Force Operational Suitability tests conducted later in the program.

Basic Layout

At this point the basic shape of the 1,000-knot interceptor has been established. To the distress of the Aerodynamics Department, a few feet of wing span have been added to achieve the high degree of inherent stability. Aerodynamics would like to argue this point, but the design is not yet ready for aerodynamic refinement. There are several major design decisions yet to be made which will be controlled by operational time and motion.

Landing gear design, while a somewhat more localized consideration than stability, is a major factor in refining the basic shape of the design. In translating operational time considerations into a landing gear design that will further relieve the operational time block, first examine the more than 300 military air accidents that occurred since January 1954 as a direct result of failure or malfunction of the landing gear system.

Detail study indicates that excessive operational extension time on aft retracting nose gears has occasioned many of these accidents. Therefore, in the design of the new interceptor, the nose gear should retract forward. The engineer also chooses high-ratio nose gear steering in order to facilitate short-time, accident-free, formation taxiing.

Nose gear failures nearly double the failure of main gears. The Structures Department says the weight penalty associated with a failure proof landing gear would be excessive. The engineer then must design a nose gear that will fail no more often than the main gear; he must stop treating the nose gear as a landing auxiliary gear, which it is not.

Next consider brakes, wheels and tires, and fairing doors. The military accident record places inadequate fairing doors, inadequate tires, and inadequate brakes at the top of the cause list in landing gear accidents. So, the engineer designs into the landing gear system a reduction in the operational time required to stop the airplane. Notwithstanding such primitive devices as

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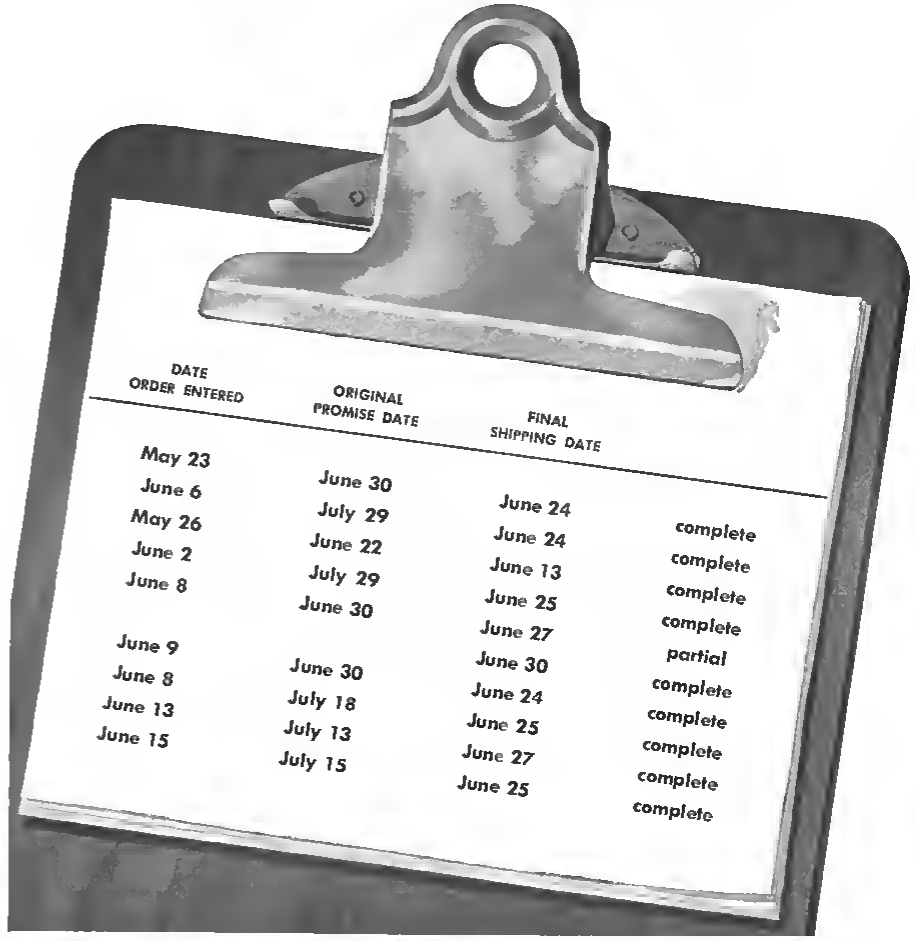
On June 15, Kaiser Aluminum was notified that North American had an emergency requirement for quantities of nine different aluminum die forgings before June 30 to prevent a serious production stoppage.

The chart at the right shows how Kaiser Aluminum met the emergency requirements —*with forgings shipped ahead of schedule.*

This fast action resulted from close cooperation with the customer, mill flexibility and Kaiser Aluminum's capabilities for service in an emergency situation. As a result, it was unnecessary for North American to spend additional time and money machining the parts from billet stock.

North American authorized Kaiser Aluminum to incur any extra expense necessary to meet their June 30 deadline. As a result of this special handling, the forgings were shipped *ahead of schedule* but with no extra billing to the customer. This fast delivery was possible without disrupting production or delivery schedules to other customers.

It's a good example of Kaiser Aluminum flexibility—that benefits our customers on routine *or* special orders!



DATE ORDER ENTERED	ORIGINAL PROMISE DATE	FINAL SHIPPING DATE	
May 23	June 30	June 24	complete
June 6	July 29	June 24	complete
May 26	June 22	June 13	complete
June 2	July 29	June 25	complete
June 8	June 30	June 27	complete
June 9	June 30	June 30	partial
June 8	July 18	June 24	complete
June 13	July 13	June 25	complete
June 15	July 15	June 27	complete
		June 25	complete
			complete

For further information, contact any Kaiser Aluminum sales office listed in your telephone directory. Kaiser Aluminum & Chemical Sales, Inc., *General Sales Office,* Palmolive Bldg., Chicago 11, Ill.; *Executive Office,* Kaiser Bldg., Oakland 12, Calif.

When you need quality forgings...

think of Kaiser Aluminum

drag parachutes, this still means large wheels, tires and brakes.

An operationally adequate design job on the landing gear system will increase the over-all bulk of the gear to the detriment of aerodynamics. However, the design is still not quite ready for aerodynamic refinement. With the need for larger wheels, tires, and brakes, wide tread, simplicity of design, super simple fairing doors, and minimum extend and lock time, the designer mounts a forward-retracting main gear in flush-mounted external-stores pods.

At this point, the engineer talks with his assistant, who, with the help of the Operational Suitability Staff, has been working out fuselage space requirements. Again, as in the preceding examples, operational time and motion was the referee, military operational records the design catalyst. He has selected the propulsion system components and has determined overall functional system space allocations as well as cockpit space allocation.

Incidentally, cockpit design is one of the less difficult time and motion design problems.

The time and motion technical decision process is applicable not only to details, but to major decisions on total weapon system concepts.

Thus is completed the basic design of a new 1,000-knot interceptor, conceptually secured on an operational time and motion basis. With this, the design is handed over for aerodynamic refinement and other classical treatment. The Operational Suitability Staff at this point assumes a monitoring and support role.

Cause for Concern

The general reaction to last spring's reports of how the Russians have shortened their development cycle is a cause for concern over the technical community's reaction. More research was the immediate cry. But what kind of research? Performance research only.

Boundary layer control, high temperature effects on structures, specialized powerplants, high-resolution radar, solid-state physics and the like are all important, but grossly inadequate insofar as realignment of the development cycle is concerned.

No significant research has been aimed toward the conservation of engineering manpower or to the speeding up of the technical decision process.

Disturbingly enough, this is only too indicative of the urgency of the operational concept. The pure performance emphasis that permeates aeronautical technology should not continue.

A plan has been offered. Technical decision via the measuring of time and motion in the user's operational envi-

ronment. This is a true panacea. Flying safety, operational suitability, weapon system integration and task force readiness are inherent in this plan. This is a plan for a marriage of two divergent time philosophies: the meditative, casual concept of time entertained by the aeronautical engineering people, and the immediate, decide-or-die concept of time held by the military operational people.

USAF Contracts

Following is a list of unclassified contracts for $25,000 and over, as released by Air Force Contracting Offices:

DAYTON AFB, Gentile Air Force Station, Dayton, Ohio.

Westinghouse Air Brake Co., Union Switch & Signal Div., 1789-1802 Braddock Ave., Swissvale, Pa., test rack, mobile type TA-1018A, Union Switch & Signal drawing $50000-1, maintenance spare parts, maintenance data and engineering data, 30 ea., RFP 33-604-56-1109, $123,258.

Grumman-New York Industries Corp., 460 W. 34th St., New York 1, N. Y., antenna position simulator SM-20/U in a/w MIL-A-4857 (USAF) maintenance spare parts, technical publication and Air Force drawings and data, 397 ea., RFP 33-604-56-1169, $126,412.

Polarad Electronics Corp., 43-20 34 St., L. I. C. 1, N. Y., signal generator AN/URM-33 and maintenance spare parts, 79 ea., FR CP-56-60960, $62,535.

Precision Instrument Co., 67-02 Hoffman Drive, Elmhurst 73, L. I., N. Y., crystal unit CR-18/U, metal pl. quartz in HC-6/U holder, Spec. MIL-C-3098-A and supplement No. 1, did. 10 Nov. 52, 52142 units, 61 items, (IFB 33-605-56-34), $66,172.

DeJur-Amsco Corp., 4501 Northern Blvd., Long Island City 1, N. Y., resistors—potentiometers, 1,906 units, 8 items, RFP 33-604-56-1251, $25,810.

Electro Impulse Laboratory, Inc., 208 River St., Red Bank, N. J., dummy load, electrical, AN/URM-59, in a/w exhibit RADC 2284 and amendments, maintenance spare parts, engrg. data and maintenance data (basic), 70 ea., RFP 33-605-56-3501, $44,840.

Raytheon Mfg. Co., Microwave and Power Tube Operations, Waltham 54, Mass., tube, electron, JAN type 2K40, receiving Klystron, in a/w spec. MIL-E-17B, did. 2 May 52, Amend. No. 3, did. 12 Nov. 53, and individual spec. sheet MIL-E-1/732, did. 1st Dec. 54, 2000 ea., RFP 33-604-56-1269, $123,125.

Tensor Electric Dev. Co., 342 Classon Ave., Brooklyn 8, N. Y., dial and mask assembly, contractor's drawing No. 12301, 250 ea., dial and mask assembly, contractor's drawing No. 12301, 500 ea., RFP 33-604-56-1038, $32,703.

Army Contracts

Following is a list of unclassified contracts for $25,000 and over, as released by Army Contracting Offices:

CORPS OF ENGINEERS, P. O. Box 2091, Tullahoma, Tenn.

A. O. Smith Corp., 310 S. Michigan Ave., Chicago, Ill., furnish and deliver regenerative air heater for flow converter D gas dynamics facility, Arnold Engineering Development Center, Tullahoma, Tenn. (IFB ENG-40-126-56-7), lot, $290,304, contract No. DA-40-126-eng-202, subcontract open for brazed radiator material.

CDC Control Services, Inc., 400 S. Warminster Road, Hatboro, Pa., furnish and deliver test fuel pressure and temperature control systems, ramjet addition to engine test facility, Arnold Engineering Development Center, Tullahoma, Tenn. (IFB ENG-40-126-(Neg. 56-12), $251,515, contract no. DA-40-126-eng-204.

Navy Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Navy Contracting Offices:

AVIATION SUPPLY OFFICE, Philadelphia 11, Pa.

Switlik Parachute Co., Inc., 1325 E State St., Trenton, N. J., Pan seats (IFB 383-211-56), 5,320 ea., $48,944.

Rubber Dipt Products Inc., Port Chester, N. Y., seal neck MK-3 -4, rubberized nylon knit, (IFB-383-369-56), various, $38,371.

L. W. Foster Sportswear Co., Inc., Hancock & Westmoreland Sts., Philadelphia 40, Pa., flight jackets (IFB-383-156-56), 9,896 ea., $240,217.

McColpin-Christie Corp., 3410 W. 67th St., Los Angeles 43, Calif., power units, (IFB-383-167-56), 80 ea., $54,373.

Telephonics Corp., Park Ave., Huntington, L. I., N. Y., headsets (IFB-383-149-00), 11,107 ea., $192,538.

Seymour Wollen & Co., 1200 S. 8th St., St. Louis, Mo., bag assys. (IFB-383-140-00), 9,500 ea., $92,070.

Scintilla Div., Bendix Aviation Corp., Sherman Ave., Sidney, N. Y., magneto & ignition harness assys., (383/2118-48/84, 383/2118-124/52), various, $140,701.

Hamilton Div., Bendix Aviation Corp., Hamilton, Ohio, services & parts for J42 P5 engines (383/23055-28P8/1/50, 383/2117-77/01), various, $348,450; servicing of fuel controls (383/23055-20P0/1/03, 383/2117-70/01), various, $28,272.

Certificates of Necessity

United Aircraft Corp., East Hartford, Conn., has been awarded three certificates of necessity totaling $20,630,000 for rapid tax amortization by the Office of Defense Mobilization for military aircraft engine facilities. The amounts certified were $2,100,000 with 60% allowed; $10,330,000 with 65% allowed; and $8,200,000 with 80% allowed.

Other recent certificates include:

Bell Aircraft Corp., Wheatfield, N. Y., research and development facilities, $170,000 certified with 65% allowed.

Curtiss-Wright Corp., Wood-Ridge, N. J., research and development facilities, $229,000 certified with 60% allowed.

Goodyear Aircraft Corp., Akron, Ohio, research and development facilities, $2,290,700 certified with 40% allowed.

Thomas A. Edison, Inc., West Orange, N. J., military aircraft instruments, $20,050 certified with 65% allowed.

The O. Hommel Co., Carnegie, Pa., components for military aircraft engines, $359,763 certified with 50% allowed.

General Precision Laboratory, Inc., Pleasantville, N. Y., research and development in electronics, $275,000 certified with 45% allowed.

Boeing Airplane Co., Seattle, Wash., research and development facilities, $19,780,000 certified with 80% allowed.

Atlantic Mastercraft Co., Bronx, N. Y., aircraft parts, $20,007 certified with 70% allowed.

Robertshaw-Fulton Controls Co., Anaheim, Calif., research and development facilities, $45,840 certified with 70% allowed.

The Glenn L. Martin Co., Middle River, Md., military aircraft, $70,000 certified with 80% allowed; military aircraft, $80,174 certified with 65% allowed.

Ex-Cell-O Corp., Lima, Ohio, military aircraft engine parts, $241,678 certified with 65% allowed.

Bendix Aviation Corp., Utica, N. Y., military aircraft engine parts, $102,500 certified with 40% allowed; Friez Instrument Div., Towson, Md., military electronic equipment, $53,241 certified with 65% allowed.

The American Welding & Manufacturing Co., Warren, Ohio, military aircraft engine parts, $149,000 certified with 70% allowed.

New Approach Points Way to Safer Pressurized Structures

By Irving Stone

Pasadena, Calif.—A California Institute of Technology research engineer has advanced a new theory for appraising the strength of materials and warns that present methods cannot meet the needs of pressurized structures in modern aircraft.

The engineer, Michael Zaustin of Cal Tech's Jet Propulsion Laboratory, has concluded that the material which is strongest in tension—generally the basis of selection—is not necessarily the most suitable for pressurized cabins or other pressurized structures such as tanks and combustion chambers.

Stresses involved in these applications tend to embrittle the material, Zaustin says.

The designer, therefore, must select material which preserves its ductility to the point of failure. This degree of ductility will produce a gradual release of energy in the pressurized system and prevent the catastrophic failure resulting from sudden release of energy experienced with materials which have become embrittled by unfavorable combination of stresses.

In some cases, a proper degree of ductility may even warn of oncoming failure by producing visible signs of excessive deformation.

Tensile Test Data Unrealistic

Standard designs of pressurized structures today use theories of failure which apply tensile strength data as the basis for strength analysis, Zaustin says. However, the behavior of material during tensile tests, according to the engineer, is entirely different from its behavior under conditions of pressurized service.

In tensile tests a neck is formed, while in a pressurized structure there is no such necking and stretch is in all directions.

For this reason, he says, a more realistic analysis of strength for pressurized structures is necessary.

This realistic analysis, according to Zaustin, is as follows:

Any material has two distinct resistances—resistance to shear and resistance to tearing (cohesive resistance).

Tensile tests give combined action of these two resistances, but in an unknown proportion. Unfortunately, there is not enough experimental data available with respect to these resistances, particularly cohesive resistance, Zaustin says. Hence, the first problem is to determine these two resistances separately.

Ratio of shearing resistance to cohesive resistance is one factor which influences the behavior of the material and the type of failure. Another factor is the ratio of shearing (tangential) stress to normal stress.

If the shearing resistance is smaller than the cohesive resistance, then the result is a tendency toward ductile failure.

However, if the shearing resistance is greater than cohesive resistance, then the tendency is for a brittle failure (without previous deformation) to result.

On the other hand, if the shearing stress is greater than the normal stress, then the tendency again is toward ductile failure, whereas if the shearing stress is less than normal stress, the tendency is toward brittle failure.

Brittle State Unreliable

Actual behavior of the pressurized structure is the result of the relationship between the resistance ratio and the stress ratio.

If the ratio of shearing resistance to cohesive resistance is smaller than the ratio of shearing stress to normal stress, the material will remain ductile under load, avoiding the danger of sudden, brittle failure. Zaustin believes that this is the condition which is necessary for the safe design of any pressurized aircraft structure.

Material in the brittle state is unreliable and may even be dangerous, according to Zaustin. Among the reasons:

- **Strength of a brittle material** is unpredictable, because the smallest internal defects may start a dangerous crack. Even in the case of standard tensile tests, the variance of experimental results is much greater with brittle than ductile materials.
- **Ductile materials** give some warning of incipient failure by excessive deformation, while brittle materials break suddenly.
- **Materials in the brittle state** are sensitive to shocks and vibration.
- **Stress concentrations** are more dangerous in brittle materials, because they have insufficient plasticity to deform and redistribute the stresses.
- **Efficiency of welded joints** is greater in ductile than brittle material. This is important from both safety and weight standpoints.

While urging further fundamental research on the nature of strength of materials, Zaustin suggests that materials that do best in static tensile tests of notched specimens will be most suitable for application in cases of combined stresses.

This means ductile materials, whose static tensile strength is improved by notching.

High-heat-treated materials that appear strongest in regular tensile tests will not generally be best when tested in the notched condition.

Ultrasonic Inspector for Jet Blades

New automatic ultrasonic equipment for inspecting axial-flow rotors will be used in the overhaul of General Electric J47 jet engines at Norton AFB, San Bernardino, Calif. Designed and built by Electro Chemits, Inc., Pasadena, Calif., the new equipment uses techniques developed at General Electric's Evendale, Ohio, plant, and is expected to reduce inspection time by at least 800% compared to manual ultrasonic procedure. Without dismantling the compressor rotor, an inspection can be made in one hour with the new equipment to detect and record the shape of invisible cracks and flaws in the rotor. A 17-in. cathode ray tube is used to give a visual report of the inspection along with a recorder that can picture the shape of any crack detected.

WHAT'S NEW

Publications Received

• **Flight Fly-Past**—Photographs by John Yoxall and L. W. McLaren—Pub. for Flight by Iliffe & Sons Ltd., Dorset House, Stamford St., London, S. E. 1, England. 24 plates 7s.6d. ($1.05), by post 8s.4d. ($1.17). A portfolio of photographs of British aircraft.

• **Jane's All the World's Aircraft 1955-1956**—Compiled and Edited by Leonard Bridgman—Pub. by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y. $25.00; 410 pp. A reference to aircraft of all countries.

Telling the Market

Modular anthropomorphic test dummies for human simulation in human factors experimental work, brochure, Alderson Research Laboratories Inc., 10 E. 38th St., New York 16, N. Y. . . . Serving the Engineering Profession is booklet explaining **aerial photography for mapping**, Abrams Aerial Survey Corp., 606 E. Shiawasse St., Lansing 1, Mich. . . . **Deep throat presses** ranging from 22 to 150 ton capacity. Bulletin 61C, Niagara Machine & Tool Works, 683 Northland Ave., Buffalo 11, N. Y.

Screen booth filters for use in power supply lines to shielded test rooms, Engineering Bulletin T-108, Lobe Deutschmann Corp., Norwood, Mass.

Travograph oxy-acetylene multiple-torch shape-cutting machine, Form ADC-707, Air Reduction Co., Inc., 60 E. 42 St., New York 17, N. Y. . . . **Dapon resin**, a prepolymer of diallyl phthalate used in radome manufacture and other protective canopies, brochure, Ohio-Apex Division, Food Machinery & Chemical Corp., Nitro, W. Va.

Stainless steel bellows-duct components and bellows assemblies, bulletins, Arrowhead Rubber Co., 2330 Curtis St., Long Beach, Calif. . . . **Precision laboratory instrument line** covering pyrometers, thermometers, thermocouples, air velocity meters, dewpoint recorders, etc., bulletin, Illinois Testing Laboratories, Inc., 420 N. La Salle St., Chicago 10, Ill.

Engineering and production facilities for precision gear manufacture, Bulletin AC503, Sargent Engineering Corp., 2535 E. 56th St., Huntington Park, Calif. . . . **Minimum mechanical property values** for all classes of hand forgings made by Kaiser Aluminum are charted in new folder covering 2014-T6 and 7075-T5 items up to 2,000 lb. weight. Kaiser Aluminum & Chemical Corp., Industrial Service Division PR355, 1924 Broadway, Oakland, Calif.

Isopropyl ether solvent applications and technical data, Technical Bulletin F-40003, Carbide & Carbon Chemicals Co., 30 E. 42d St., New York 17, N. Y. . . . **The Shape of Things to Come**—A Blueprint of Safety Breathing Equipment for Higher Altitudes surveys jet transport requirements, Scott Aviation Corp., Lancaster, N. Y. . . . **Silicone rubber high-temperature wires** for aircraft, in sizes No. 22 through 8 AWG, bulletin, Construction Materials Division, Wire & Cable Dept., General Electric Co., Bridgeport 2, Conn.

Investment castings for producing small components with difficult contours, four page reprint, Eco Engineering Co., 12 New York Ave., Newark 5, N. J. . . . **Quill-type hydraulic power units** for step drilling and other machining, Bulletin 45352, Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich. . . . **Gear Train Design Simplified**, pamphlet, Washington Machine & Tool Works, Inc., 1001 Washington Ave., South, Minneapolis 15, Minn. . . . **Contract manufacturing facilities** for precision parts, brochure, Lycoming Division, Avco Manufacturing Corp., 550 S. Main St., Stratford, Conn. . . . **Gage blocks and accessories**, Catalog No. 56, Webber Gage Co., 12912 Triskett Rd., Cleveland 11, Ohio.

Twin-Engine Commercial Trainer

A two-place twin-engine (piston) procedures and navigational flight trainer has been developed by Link Aviation Inc. The Link E-600 will soon be delivered to Flight Safety, Inc., LaGuardia Airport, N. Y. where it will be used in advance training programs for commercial pilots. Its radio equipment (much of it dual) is said to be unusually complete for a trainer. It also features electronic navigational gear and full cockpit instrumentation, switches and controls. Included are means for the instructor to initiate failures in engines, start engine fires, introduce malfunctions in radio or navigational equipment, simulate wing ice and create many other hazardous flight conditions. General cockpit equipment and layout resembles the Convair 340, according to Link spokesmen.

Swiss Try Helicopters for Rescue

BRISTOL SYCAMORE helicopter demonstrates rescue on Lake Thun. Dangling line, fitted with buoyant globes is guided to swimmers. Despite Switzerland's rough terrain, few helicopters are in service there. Swiss pilots feel they have insufficient ceiling, low payloads.

HILLER HELICOPTER of Swiss Army is used to speed injured person to hospital. Swiss Flying Mountain Guard uses all types of aircraft to rescue people after mountain accidents.

Rearward Seating Urged for Airline Use

One perennial argument in aircraft design centers around the use of aft-facing seats. A strong proponent of that type of seating is Horace E. Campbell, M.D., chairman of the Automotive Safety Committee of the Colorado State Medical Society and a co-opted member of a similar committee of the American College of Surgeons.

Dr. Campbell's work with automobile accidents dates back several years, in 1953, as one result of the work of his committee, the Colorado State Medical Society sent a resolution to all of the automobile manufacturers urging them to incorporate such features as safety belts, impact windshields and instrument panels, and impact resistant seats and doors.

His views on seating for air transports are presented here.

Research and sober experience have made it very clear that the human body can tolerate a very severe blow—such as a fall—upon the back, but is much more vulnerable to blows from other angles.

An investigation by Hugh de Haven published in 1942 relates instances of survival in falls from heights as great as 150 ft. From this height the speed at impact is over 60 mph. Yet these persons survived because they landed more or less on their backs, and on surfaces, such as soft ground or metal ventilators which yielded somewhat, as much as 4 to 8 in.

When a crash of a military plane is imminent the personnel have worked out a standard pattern of behavior based on theory plus survival. They sit on the floor facing backward, with their backs pressed firmly against a bulkhead and a cushion pressed firmly behind their heads. This same physical situation can be achieved by rear facing seating and the military transport services have not been slow to utilize this arrangement.

RAF Experience

The Royal Air Force Institute of Aviation Medicine has released a report of an eight-year experience with rear facing seats. In summarizing here the experience of twin engined planes only, crew injuries are used as an index of the relative severity of the crashes.

The crew sitting in forward facing seats in the most vulnerable part of the plane, provides a standard of comparison between the effects of rear facing and forward facing seats for the passengers.

Killed and Seriously Injured in Crashes of Twin-Engined Military Transport Planes Classified as "Declared to the Royal Air Force of Israel Beilain"

	CREW	PASSENGERS
Forward Facing (Dakota)	42.1%	41.9%
Rearward Facing (Valetta)	6.0	1.7.0

Here the planes with rear facing seats were involved in more serious crashes, as indicated by the greater percentage of crew deaths and injuries, and yet the passenger deaths and injuries were markedly less. Since these figures are based upon an eight-year experience, they constitute for this writer, proof that rear-facing seating will prevent deaths and injuries in the civilian airlines.

European airlines have begun to provide rearward seating and a limited number of crashes to date have confirmed the military experience that survival is thereby increased.

An increasing number of Americans have ridden on these European airlines, and all the reports that have come to me are to the effect that there is no discomfort involved, and vision is improved. Those who may feel that they cannot ride backward find that only on take-off and landing are these effects noticeable, and that while aloft they are as comfortable as when facing to the front.

American military aviation has a much shorter experience with rear-facing seating than Great Britain, but this experience has led one influential officer to state: "This command has been studying the reactions of the passengers to the rearward-facing seats and finds that comfort-wise there is no difference to the passengers. It is our opinion that, safety wise, rearward facing seats are a must.

"This command sees fit and deems it necessary to require all future passenger-carrying aircraft to come equipped with the rearward-facing seats in the interest of safety."

The only things that could seem to deter the airlines in their adoption of rear-facing seating would seem to be a fear that business may decline. They must be assured by the traveling public that aviation has come to stay. We like to fly. It would seem to most of us that more of us would fly if it were made safer. Why carefully publicized safety features should drive away business is more than this writer is able to comprehend.

Some of the spokesmen for the airlines point out that often a wingtip touches the ground first and converts the initial impact into a tail first impact. That this does sometimes occur is a fact, but it is certainly not usual. As long as airplanes fly nose first and tail-last the principal impact usually is going to be from the front, and rearward-facing seating is the logical antidote. This contention of the airlines' spokesmen will be cited in another connection later on.

Seat Redesign Needed

It is not enough simply to turn the current seats around.

First of all, the seat must be designed anew, and while this is being done, certain new aspects must be considered. The seat backs must be higher than they are now. This will bring two advantages. It will support the head even though the body may rise in the seat against the slack of the belt and will protect the head from being struck by collapsing or falling roof structures. Many persons have survived the initial impact only to succumb to a blow from the hat rack. A high seat back would have taken this blow, and saved the passenger's life.

Since the direction of impact is not always or at least wholly from the front of the airplane, the armrests must be designed to be impact-resistant and energy-absorbing. All too frequently, injuries have been inflicted by lateral force components acting through the arm rests which have been designed and constructed as though the impacts to be expected were almost wholly from the front of the plane.

Seat Anchoring

Actual crash conditions are a complex of forces from every possible angle yet there has been no implementation of this concept in seat designs. It would seem logical to provide some sort of lateral support for the whole torso of the passenger. A seat back, looking something like the barrel back or wing back chair which would protect head and chest from lateral forces would seem to be a possible development.

We must carry the discussion further to consider the fundamental structure of the current transport plane. It is a

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Unique Identification System *Saves Time, Saves Weight, Saves Money!*

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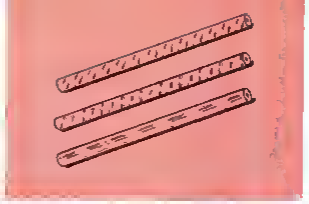

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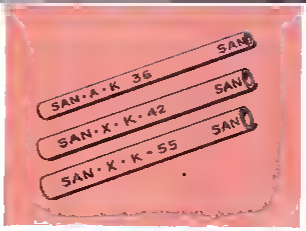
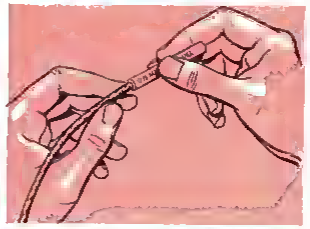


WW500 CUTS ASSEMBLY COSTS. Eliminates tags and clamps. Tagging takes time, piles up labor costs. Tags can and do drop off.



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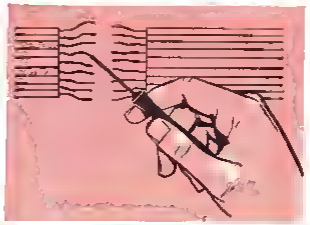

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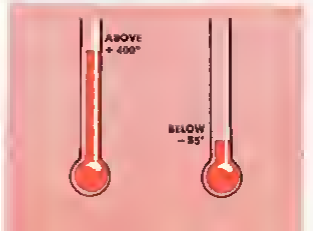

Advantages

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- Cuts assembly costs
- Can be used anywhere

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- World's most heat-and-cold resistant cable. Operates efficiently in temperatures *far above* +400°F to *well below* —85°F.
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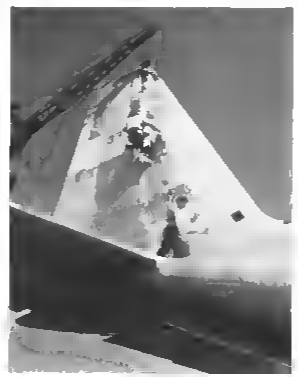
matter of record that a large proportion of current seats tear loose from their fastenings and collect in the forward areas.

The seat belts do not fail, and do not inflict serious injury to the passenger, but the whole seat—belt passenger and all—goes plummeting toward the front of the plane and it is then that the serious injuries are inflicted.

Thus it is somewhat irrelevant whether the seat faces to the fore or to the rear, if the construction of the airplane does not permit seats to maintain their anchorage.

In the automobile, the seats are so flagrantly flimsy that initial standard practice is to fasten the safety belts to the floor or to the frame of the car. In planes now in operation with forward facing seats, perhaps this modification should be made at once. Certainly the ordinary 3,000 lb. belts now specified by CAA are stronger than the seat floor attachments now provided, and it is time to increase the present forward inertial load factor of the seats and moorings from the current 9G to a more realistic figure.

Certainly, structures strong enough to hold the seats in position up to the point of destruction of the floor itself must be provided. It would seem logical to take a tip from the more enlightened automobile designers who have made the car frame and body an integral structure and design the floor and seat structures as a unit. This could easily lead to greatly increased in-



Clean-Up Detail

Crane lifts one workman in bosun's chair to wash, wax and buff the 38 ft. high tail of Lockheed's big C-130 Hercules transport while another uses the horizontal stabilizer as a catwalk to get at lower part of fin. Treatment gives the USAF transport protection against elements and the exhaust from its four Allison T56 turboprop engines.

pact resistance and might even result in reduction of weight.

"Aircraft seats were for years designed with forward accelerations of approximately 6G," an aircraft designer told me. "A few years ago when 40G military requirements were introduced there was great objection owing to the weight of the additional strength. A careful engineering approach, however, indicated that 40G seats could be designed even lighter than the earlier 6G seats."

The 40G military requirement brings up the question as to whether it is not time to increase the inertia load specifications of our airliners.

'Built to Crash'

In 1946 De Haven wrote: "Up to the present, aircraft have been built solely to fly, not to crash. This single approach in design has been costly in the past and is no longer acceptable in military aircraft where a few pounds of extra weight to give added crash protection has been an important concession."

This concept of building the airplane to crash as well as to fly has brought about the 40G military requirement, and the important saving of costly personnel is a matter of record.

While it is not in our mind to recommend that the civilian plane be as strong as the military plane, yet so long as over 90% of the passenger seats pull loose with a relatively intact hull, it is obvious that we need to increase the strength of the weak link in this chain, and perhaps even increase the strength of the entire chain.

The inertia forces stipulated in British civil airworthiness requirements are not greatly different from ours. But an appendix states: "It is recommended that inertia forces corresponding to higher accelerations than those prescribed should be used for the design of the seat and equipment attachments, etc., in light airplanes and aft of the main spar of larger transport airplanes since in the event of a crash involving such higher accelerations, it is desirable to protect the occupants from injury by detached equipment and seats, and maintain the chances of survival at least at the level which safety belts are able to provide (i.e. 20G)."

Anatomy as a Guide

With this type of thinking as a basis let us proceed in our quest for a formula. First of all, we must admit that airplanes are made by human beings, and may be made in almost any way these human beings care to make them. But human beings are made—well, we must take them as they come. Since we are making airplanes to transport human beings it might be logical to start with human anatomy as a guide in the design and construction of the airplane.

Lt. Col. J. P. Stapp has demonstrated that human beings can tolerate relatively comfortably a short-duration gravity increase of about 50G. Survival tolerance is obviously higher than this. Actually, as shown by De Haven in the study mentioned earlier, gravity increases in the prone position can be tolerated up to 200G. Stapp's experiments largely involved the forward-facing position, and greater tolerances likely can be achieved in the rearward-facing seated position.

Let us accept the figure of 50G for the rearward-facing position for passengers seated aft of the main spar. Let us provide a seat that will withstand inertia loads of this extent, not only forward (as regards to the airplanes) but at angles of 30 degrees to the left and right. This will result in a realistic lateral loading of 25G (for the seat), and then, since we know that the plane will often come to rest 180 degrees from its original direction, let us provide a rearward loading of 10G.

The floor must then be constructed to provide support and restraint for seats of this strength, and again let me suggest an integral design of floor and chair structure. Only thus can the requisite strength be attained without excessive weight.

From here on, build whatever hull is necessary to accommodate economically the structures thus far prescribed. If the British can provide protection for passengers "at least at the level which safety belts are able to provide (i.e. 20G)" in the current 9G airplane,

SOLID CARBIDE CUTTER designed at Glenn L. Martin Co. successfully routes panel cutouts of many dissimilar materials. This operation formerly caused rapid breakdown of highspeed steel cutters. New Martin unit has successfully routed over 500 cutouts in panels of laminated phenol-fiber, fibrous glass and dural and shows no sign of breaking down. Earlier steel cutters failed after making two cutouts.

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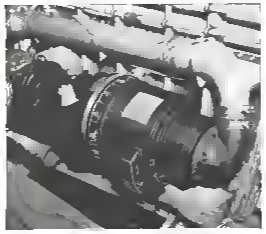

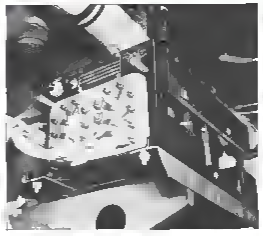

These photos taken on the F-102A production line at the Convair Div. of General Dynamics Corp. show the three Jack & Heintz a-c system components in process of installation. The generator (left) mounted with a Sundstrand constant-speed drive is located in the aft fuselage. The control panel (center) and voltage regulator (right) are mounted in the ship's nose.

* * *

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weight will not need to be greatly increased, if a careful engineering approach is utilized

Price of Safety

Only for the sake of argument, it will here be admitted that the weight will be significantly increased. One can imagine that wiseacres in the industry will shake their heads and say, "The public will not pay the increased cost."

To this, the completely logical reply is that we are paying for safety already without getting it, and we might as well have the increased safety since it will cost us nothing but a little thought and careful engineering.

In the form of death and injury losses, increased insurance rates and cost, loss of revenue (for there are thousands of people who are not yet flying because they know it is not as safe as it can be made to be) the public is paying for the safety it is not getting.

British military aviation has demonstrated a sound reduction in passenger mortality and serious injury from 44.9% to 17.0% in the category of "destroyed two-engined aircraft," and this without an extensive redesign.

Enlarging the category to include "destroyed and substantially damaged" aircraft, and including four-engined aircraft as well, the percentage of passengers killed and seriously injured has been reduced from 21.6% in the forward-facing planes to 6.4% in the rear-facing-seat planes.

This writer is confident that a more recent report would demonstrate an even better figure.

Aviation today provides safer transportation per passenger-mile than any other form now available, including walking. But it can be made safer still, and we want it that way now.

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3. DE HAVEN: Current Safety Considerations in the Design of Passenger Seats for Transport Aircraft, Aviation Crash Injury Research, Cornell University Medical College, New York City.
4. GRATZ, C. M.: Biomechanics—A New Approach to Airplane Safety, Mechanical Engineering, May 1944, pp. 313-314.
5. GRONOW, G. C.: Backward-Facing Seats in Aircraft for Increased Passenger Safety, R.A.F. Institute of Aviation Medicine, Royal Aircraft Establishment, England.
6. HOVGAARD, P. E.: Biomechanics—A New Approach to Airplane Safety (Discussion of Gratz paper), Mechanical Engineering, September, 1944, pp. 613-614.
7. STAPP, J. P.: Human Exposures to Linear Deceleration, Part 1 and Part 2, A.F. Technical Report No. 5915, June 1949 and December 1951.

WHO'S WHERE

(Continued from page 23)

David G. Soergel, manager, applications department, Autonetics Division, North American Aviation Inc., Downey, Calif.

A. C. Kotchian, assistant general manager, Lockheed Aircraft Corp.'s Marietta (Ga.) Division. Other Lockheed-Marietta changes as a result of the firm's executive development program: **R. R. Kearton,** director of administration; **R. J. Osborn,** assistant manufacturing manager; and **H. L. Poore,** assistant production manager.

Arnold K. Weber, director of manufacturing, Radio Corporation of America, Camden, N. J.

Ken Brigham, public relations supervisor, Philco Corp.'s Government & Industrial Division.

T. N. Baker, assistant to the president and general sales manager, Air Logistics Corp. **E. M. Armstrong,** assistant general sales manager; **R. J. Smithland,** chief sales engineer; **H. Danowsky,** chief service engineer; **John W. Thorp,** president, Thorp Aircraft Corp., has been engaged as a design consultant.

H. C. Leclere, manager, Plant 2, Link Aviation, Inc., Binghamton, N. Y.

Correction

Dr. William R. Sears, new editor of the Journal of the Aeronautical Sciences, retains his position as director of Cornell University's graduate school of aeronautical engineering. It was previously inferred (AW Jan. 2, p. 55) that Dr. Sears had left the University to take on editorship of the Journal.

Escape Capsules for Jet-Age Airmen!

With the advent of the jet age, "bailing out" of supersonic aircraft became a highly hazardous feat

So much so that the Defense Department made *"safe escape"* a top priority project

A way had to be found to enable pilots and crewmen to get out of an aircraft in distress, a way for them to bail out at awesome heights while flying at speeds faster than sound—a way that would protect them from the blast of the high speed air stream, keep them from "blacking out" from lack of oxygen.

Five years ago Goodyear Aircraft Corpo ration, at the invitation of the Navy Bureau of Aeronautics, became actively engaged in the problem Shown here is the result·

A veritable "escape envelope"—a human capsule—to bring jet airmen back alive

Designed to fit any battle station on a supersonic aircraft, the Goodyear Aircraft Ejectable Seat Capsule is a complete escape cell for any crew member—a self-contained envelope built around the seat in which he sits.

In emergency, a quick automatic sequence of actions encloses him in the complete "escape capsule" which is then catapulted from the aircraft. A pilot parachute opens to stabilize and decelerate the capsule — then, at a lower altitude, a full-size chute mushrooms forth to bring him safely down

The capsule is sealed—watertight and air-tight—contains a life raft, oxygen supply independent of the aircraft.

Above all it is lightweight, engineered of special Goodyear-built reinforced plastics and honeycombed structural material — a must in modern-day aircraft where every ounce of weight is critical.

Already tested on a supersonic sled-track at speeds equivalent to Mach 1.5 at high altitude—one and one-half times the speed of sound—the Goodyear Aircraft "human capsule" will enable future airmen to tackle new frontiers with a new assurance of safety and survival.

They're Doing Big Things at

GOODYEAR AIRCRAFT

Opportunities Unlimited for Engineers • Plants in Akron, Ohio, and Litchfield Park, Arizona

SIMPLE CONSTRUCTION in new Bernardi Aeroscooter will permit price of about $1,300.

Italians Test 'Flying Motorcyles'

Rome—Flight tests have started on a series of light "flying motorcycle" aircraft designed to replace the more traditional vehicles on large farms and ranches. They are also seen as low-cost primary trainers.

The designer, Mario de Bernardi, one of Italy's highspeed seaplane racing pilots during the Schneider Trophy races in the 1920s, says his Aeroscooters will cost approximately $1,300 in production quantities of 100.

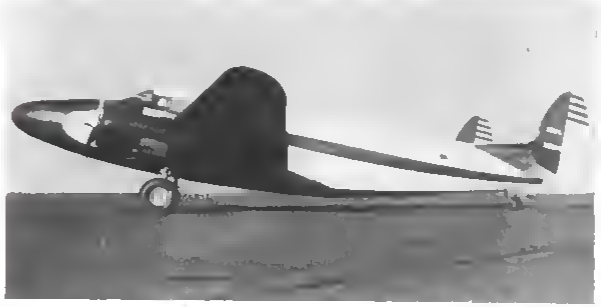
Bernardi also reported that he is now negotiating with some Australian customers who are interested in using the Aeroscooters for ranch work.

Both single and two-place Aeroscooter prototypes are now flying. Bernardi states that the two-seater later will be fitted with a small helicopter-type rotor atop the cabin, for emergency landings on rough terrain this would be driven by a bottle of compressed air to permit vertical ascent.

Basic construction includes wooden wings, metal fuselage and tail boom. The boom is designed to exhaust gases from the two-cylinder 40 hp. air-cooled engine and eject them through its open end to provide additional thrust. The two-seater has slightly greater wing area than the single seater, its performance is some 5% lower.

Dimensions and performance characteristics of the single-place Aeroscooter: Span, 27.1 ft., length, 17 ft., height, 5.5 ft., wing area, 88.8 sq. ft. Gross weight is 660 lb. and empty weight is 440 lb. Top speed at sea level is reported to be approximately 100 mph., cruise speed as about 87 mph. and minimum flying speed as 37.2 mph. Service ceiling is 13,120 ft. The plane can land in an area 160 ft. x 33 ft.

The planes were built by M.d.B. Spa Co., 85 Via Panama, Rome.



U. S. Steel Buys Learstars With Radar

This is the first of two Learstar business transports purchased by U. S. Steel, both planes having Bendix/band weather radar. The aerodynamically clean nose radome, engineered and installed by Lear Aircraft Engineering Division, Santa Monica, Calif., extends the normal Learstar's nose by 24 in. The U. S. Steel planes are the first Learstars fitted with weather radar. A number of other eLarstars are slated to get this equipment.

Jet Wing Vortices Present Pilot Danger

The trailing wingtip vortices of jet fighters, rather than the wake of turbojet engines, poses a real danger to lightplane pilots according to a study by Britain's Royal Aircraft Establishment, Farnborough.

Flight tests were made with a Gloster Meteor twin-jet fitted with smoke canisters at the wingtips. A de Havilland Vampire jet fighter flew behind the Meteor to judge the effects.

Blast velocity from the Meteor's jet engines dropped to a negligible value 200 to 300 ft. behind the Meteor. Turbulent wingtip vortices generated by the Meteor, however, lost only half their strength at 8,000 ft. behind the plane, causing severe rolling tendencies on the tracking aircraft that in some cases could not be overcome by use of ailerons.

Similar dangers exist from wingtip vortices of large airliners, especially when flying at low speed, such as during approaches to terminals, the British report said. With increasing numbers of jets and airliners operating from commercial terminals, lightplane pilots are warned to maintain safe distances and to cross the wakes of these airplanes above and below their level.

PRIVATE LINES

On-the-spot pilot proficiency checks is a new corporate aircraft service offered by Flight Safety, Inc., LaGuardia Airport, N. Y. Three-day ground and flight training program is accomplished by firm's team at the customer's home base.

Aero Commander executive transport has been purchased by Clifford B. Hannay & Son, Inc., Waterloo, N. Y., which expects to log some 120,000 mi. in the coming year on its new plane in serving hose reel customers.

Remmert-Werner Douglas DC-3 conversion with R1830 Super-92

engines has been acquired by Big Three Welding & Equipment Co., Houston, Tex. The 14-seat transport has Collins VHF communications with dual omni and IIS, dual Bendix ADF radio compasses and Sperry autopilot.

Removal of Beech D18S intake extensions is authorized by Civil Aeronautics Authority provided the cutoff is accomplished at the cylinders' forward face, to prevent oil leaks from entering the modified intake. Business pilots have reported that removal of the intake extensions reduces induction icing.

Radio Corporation of America is scoring in business plane weather mapping radar installations. Among the latest are two installation of AVQ-10 C-band gear in DC-3s owned by Scott Paper Co. and National Dairy Products, Inc.; both performed by Reading (Pa.) Aviation Service, Inc. Reading uses an installation having a 22-in. dish and radome fabricated by Chamberlain Aviation Corp., Akron, Ohio. Two earlier AVQ-10 installations, using a 30-in. dish, both by AiResearch Aviation Service Co., Los Angeles, Calif., were made on RCA's DC-3 and Lord Motor Co.'s DC-3.

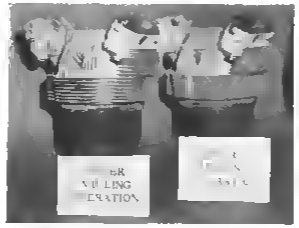
Modification of British Auster J-1 Autocrat permitting installation of 130-hp. DH Gipsy Major 1 engine replacing standard 100-hp. Gipsy Minor 2 has been developed by the airframe manufacturer. Delivery of the modified planes takes 6-8 weeks. Cruise speed of the modified Autocrat J-1N is 105 mph. at 2,100 rpm. at 1,000 ft., fuel consumption is 6.5 gal./hr.

Civil Aeronautics Board is circulating Draft Release 55-29 which proposes to modify CAR 43 to require that transport category aircraft and those certified under SR-407 do not exceed authorized maximum takeoff and landing weights for the elevation of the field from which the plane is flying. Many pilots have interpreted CAR 43 to allow them to use sea level maximum takeoff and landing weights regardless of airport elevation. CAB seeks comments on its draft release in duplicate by February 10th.

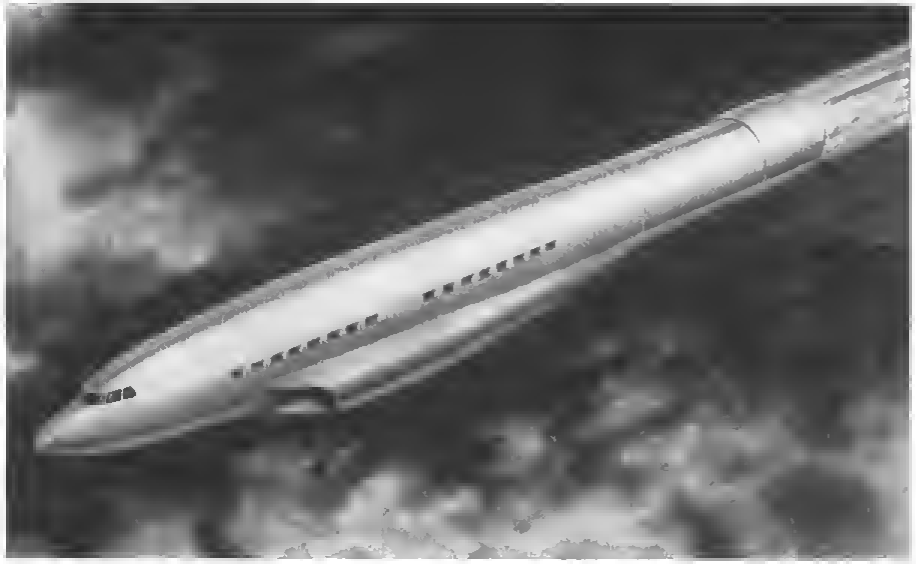
Cuban Minister of Public Works has taken delivery of a Bell 47H-1 helicopter to aid him and his staff in supervising widespread simultaneous construction projects underway on the island. The Ministry expects to order two Bell 47G-2 helicopters later for similar service.

Plymouth Oil Buys 300-Mph. Super Ventura

Luxurious Lockheed Super Ventura conversion developed by Howard Aero Service, San Antonio, Tex., has been purchased by Plymouth Oil Co. Plane has a cruise speed of over 300 mph. on a 2,300-mi. range carrying two crew, 14 passengers and over 1,500 lb. of luggage. Feature of the Howard Super Ventura is a fuel system comprising 1,300 gal. in two center section and one outer wing tank on each side. Fuel from opposite tanks may be used for either engine without using a cross-feed section; each engine having an auxiliary boost pump. Howard reports that it currently has four Super Venturas being converted for customers and are negotiating five additional airplanes. Production rate is one a month and is expected to be increased in the latter part of this year. Basic Super Ventura price is $275,000 plus interior and radio.



REVISED R1820 HC CYLINDER (left) features solid shrunk-in seat replacing buttress-type seat and modified head finning to provide longer life and more efficient cooling, Durham Aircraft Service, Inc., reports. The Woodside, N. Y., firm says that the purpose of its modification was to provide the old-type cylinder with characteristics similar to the newer R1820 HD and HE-series. Approved by CAA, the revision costs approximately $125 per cylinder. Durham notes that several business aircraft operators have ordered the modification on their engines.



WINGLESS, TAILLESS AERODYNE of the future as envisioned by Dr. A. M. Lippisch of Collins Aeronautical Research Laboratory

Navy Underwrites Aerodyne Research

Under Navy sponsorship, Dr. A. M. Lippisch has developed a wingless, tailless aerodyne model powered by internal propellers.

The model shown in picture at right, has undergone successful tests at Collins Aeronautical Research Laboratory in Cedar Rapids, Iowa. Dr. Lippisch hopes the research program will lead eventually to an aircraft able to rise and descend on a vertical plane, capable of supersonic speeds and similar to the artist's sketch above.

Principal design feature behind the proposed aerodyne is the internal propellers that provide power by drawing in air at the top and expelling it at the bottom.

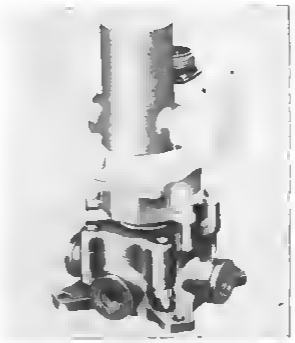
Dr. Lippisch, a native of Germany, is best known for his World War II design and development of the Messerschmitt 163, the world's first operational rocket-propelled fighter.

His later work included designs for a ramjet-powered, delta-winged fighter that utilized a fuel consisting of processed coal.

At the end of the war, Lippisch was brought to the U. S. and worked at Wright Field before joining the Collins firm.

MODEL, powered by internal propellers, hangs in mid-air under Dr. Lippisch's control.

NEW AVIATION PRODUCTS



Selector Valve for Hydraulics

New four-way motor operated selector valve designed for aircraft high temperature hydraulic systems can change position in a half-second at −65F and remains in position without using electric current. Operation is independent of hydraulic system pressure.

Production units operate to 275F and function in pressure range of 0-3,000 psi. Both ¾-in. and ½-in. tube size models come with 24-v. d.c. motors. Optional equipment includes a manual override and switches for signal lights.

General Controls Co., Glendale, Calif.

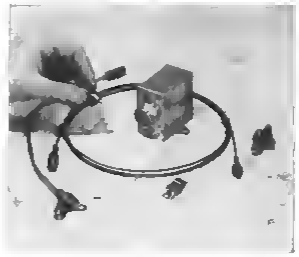
Detector Gives Pre-Fire Signal

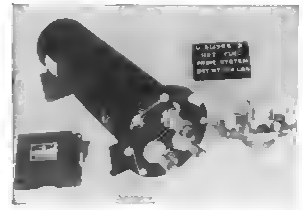
Aircraft fire detection system warns of potential fire by providing an immediate engine nacelle overheat signal, then a fire signal if that condition occurs. Fire alarm always overrides an overheat condition.

The system is based on both fixed temperature and rate of temperature rise principles. The control unit uses transistors instead of vacuum tubes. The control box is hermetically sealed, but an unsealed version is also available.

A typical nacelle installation weighs less than 3 lb.

Walter Kidde & Co., Inc., 256 Main St., Belleville 9, N. J.





Fuel Primer for Cold Weather

Hot fuel prime system for piston engine use when operating in sub-zero temperature will raise fuel from −65F to 220F in two minutes, minimizing battery and starter wear. It can be used with or without the maker's de-aerating

R4-D On Federal Skis in Antarctic With Previous Navy Expedition

cold weather oil system (AW Aug 24, 1953, p. 38).

System operates on the 24-v engine starting current source. It can also work from 208-v three-phase ac power systems. Installation is in the accessories section of the engine nacelle forward of the firewall. Dry weight is 11.4 lb.

United Aircraft Products, Inc., 1116 Bolander Ave., Dayton 1, Ohio.

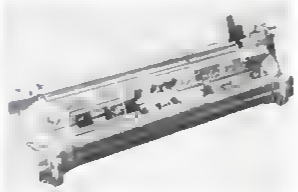
Fan Ventilates, Then Seals

Shut-off blower, having special utility in ground cooling or for ventilating radar equipment, uses only one motor for ventilation and sealing cycle. Spring-loaded iris-type fins close the ventilator when power shuts off.

Two models are available. A398, which delivers 70 cfm at 5 in. of

water and A447, 600 cfm at 8 in. of water. No additional envelope is required apart from duct diameter. Valve mechanism requires only 1 in. space axially.

Lundy Manufacturing Corp., 36-08 33 St., Long Island City, N.Y.



Torque Measures Flow Rate

Inertial mass flowmeter for gaging liquids or gases imparts a known constant angular velocity to the material flowing through the meter. Then, by

measuring the torque required to stop the rotation, the rate is calculated using proportional signals.

Flow rate is displayed on a dial or a digital counter. Signal may also go to a totalizer. Unit features a constant-speed drive independent of temperature, applied voltage and frequency. A readout system of the self-balancing bridge type is available for either an analog or digital output.

Inertial Instruments, Inc., 2029 Broadway, Santa Monica, Calif.

ALSO ON THE MARKET

Flush toggle switch cover (model H34 plate-covered model 1135 bracket-mounted) has flush trigger and cover available in wide range of offsets to fit a variety of panel thicknesses. Switches are rated 10-20 amp 125 v a-c per pole and up to 4 PDT can be provided. Self-contained switch guard prevents accidental actuation from shock when cover is closed—Hartwell Aviation Supply Co., 9035 Venice Blvd., Los Angeles 34, Calif.

Resistance-type strain gages for use up to 1,800F are of etched foil type, using 0.0005-in.-thick grid on a temporary carrier which is stripped off when applying them, leaving the grid imbedded in ceramic cement. Nichrome, Nichrome V and Constantan grids are available in lengths of 1, ½ and ¾ in.—Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.

Breadboard equipment has servo plates reinforced with stainless steel sheets for extra rigidity and hangers and accessories fastened to the plate from the top side with T-nut cap screws. Slots provide wide adjustment range of equipment.—Sterling Precision Instrument Corp., 34-17 Lawrence St., Flushing 54, N. Y.

Aluminum sheet feeding table has 48x192-in. top, lowers to 26 in. and elevates to 40 in., using foot switch.—Raymond Corp., 102-138 Madison St., Greene, N. Y.

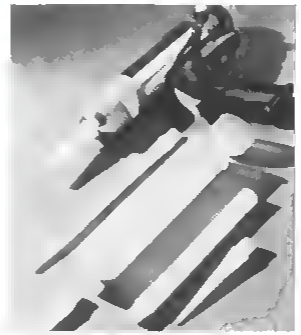
Terminal strips meeting AN3436 standards have post-type barriers and studs for attaching single or multiple terminal-ended wires. Available with No. 6 studs in 1-20 circuits, No. 8 or No. 10 studs in 1-16 circuits and with ¼-in., ⅜-in. and ½-in. studs in 1-8 circuits. Bases are molded of CMI-5 compound.—Buchanan Electrical Products Corp., Hillside, N. J.

Magnetic 16-mm sound-on film in color and black-and-white is now available for Auricon cameras for precision

aviation data recording. Filmagnetic unit, installed at the factory, can be temporarily removed without tools—Berndt Bach, Inc., 6900 Romaine St., Hollywood 38, Calif.

Inorganic film type heating element windshield deicer operates at 500F. Unit uses 1,000 w. Compartment heater, using 1,500 w., has outlet temperature of 200F at 6 lb./min., with air intake of 60F. Heater meets MIL-E-5272A and operates 1,000 hr. at 465F with no change in resistance—Universal Metal Products, Inc., Bassett, Calif.

Sealant gun for aircraft use uses disposable cartridges and nozzles of molded Tenite polyethylene, which does not



react with or affect properties of caulking compounds—Pyles Industries, Inc., 8926 Second Ave., Detroit 2, Mich.

Th Temp Kilotrol pressure switch operates in temperatures to 800F. Burst pressure is 10,000 psi, surge pressure is 4,500 psi. Operating pressure at 800F is 3,100 psi. Contacts are SPST ½ amp at 28 v. d.c.—Cook Electric Co., Duphlex Division, Chicago, Ill.

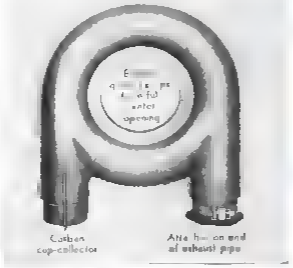
Dual-wheel 16-in. shock preventing caster A17S16 has been developed especially for high speed surface transport of jet engines, missiles and similar cargo on and off paved surfaces. Wheels are cantilever-mounted with independent suspension systems having 3-in. total amplitude of mechanical deflection—Modern Caster Co., Rockford, Ill.

High-temperature aircraft locknuts using A286 stainless steel alloy have short time tensile strength of 105,000 psi at 1,200F. Stress rupture strength at 1,200F after 100 hr. is 64,000 psi.—Elastic Stop Nut Corp. of America, Union, N. J.

Fuel gage tank unit tester Model 1617-040 works with all capacitance

type equipment and measures volume directly without use of correction cards or interpolations Three ranges of capacitance are provided 0-100 uuf, 0-1,000 uuf and 0-5 000 uuf Equipment meets specification MIL-T-4687A —Aven, Inc, 5815 Northern Blvd, Woodside, N Y

Spark arrestor for safetying exhaust of ramp vehicles employs centrifugal principle that eliminates need for dirt-collecting screens. Unit is said to cause negligible engine back pressure Some



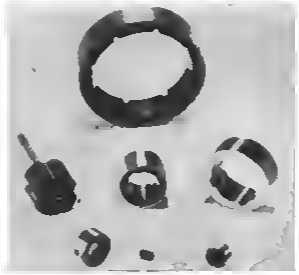
of this equipment has been purchased by United Air Lines—Erickson Products Co, 43 Dore St, San Francisco, Calif

Pushbutton actuator for switches, designated 4MA and 5MA series have high pre-travel to provide good feel and prevent accidental operation Actuator can be mounted through panels ⅛-in. to ¼ in thick —Micro Switch, Division of Minneapolis Honeywell Regulator Co, Freeport Ill.

Explosive valve for long-time storage of fluids or gases under pressure has maximum operating pressure of 5 000 psi and proof pressure of 10,000 psi Weighing 5 oz. unit is 3½ in. long Explosive squib, sealed in a chamber is fired by ½ amp —Explosive Products Division, Conax Corp, 7811 Sheridan Dr, Buffalo 21, N Y

Direct setting Electro-Limit gage works to 0 0001 in without masters and also gives comparative over and under readings direct to 0 00005 in on a full scale of plus or minus 0 001 in. Gage's total range is 6 in Squareness thread gaging fixture provides inspection range of ¼ in to 1¼ in thread diameter using interchangeable roll holding plates and gaging rolls Accuracy is approximately 0 0002 in total indicator reading at 1¼ in diameter—Pratt & Whitney Co, Inc, W Hartford 1, Conn.

Plastic-bound permanent magnets of intricate design can be mass-produced



by new method of manufacture that also makes it possible to press shafts, temperature compensation pieces and bearings into the magnets. No machining is needed. The method also offers high-precision magnetic tolerances, low aging requirements, low cost.—Baermann-Nord Corp., Amherst, Ohio

New Machine Speeds Aluminum Treatment

Protection of aircraft aluminum parts against corrosion and abrasion is sped by use of a new machine, known as an Auto Cycler, at Torrance Location of Douglas Aircraft Co.'s El Segundo Division. The machine also prepares metal surfaces for good paint adhesion.

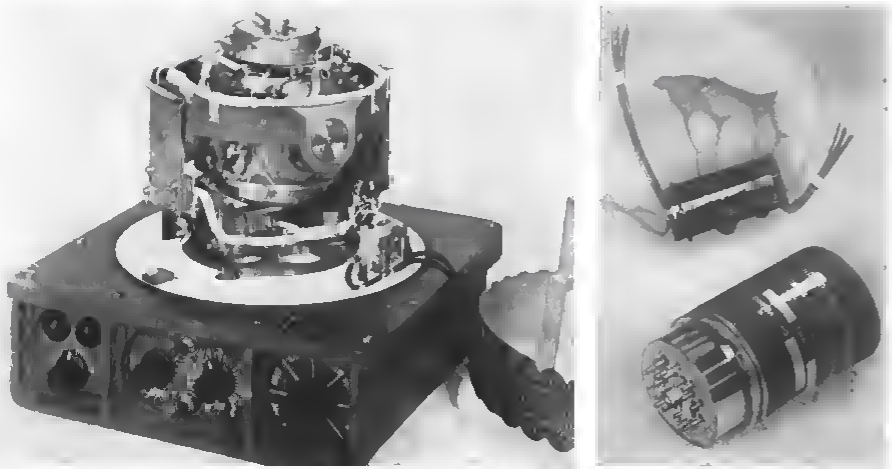
The Auto Cycler is said to require two-thirds the time of the method it replaces and uses only two immersion tanks instead of 10. It occupies 600 sq. ft. of floor space, in place of the older method's 2,000 sq. ft.

Parts to be treated are racked and firmly anchored in the immersion tank, to keep them from moving while they are subjected to the action of high-velocity liquids. The wash treatment, rinse and air drying all take place in the single chamber.

The technique was developed by the Plant Engineering and Materials & Process Engineering groups, and constructed by maintenance department.

NAA's Atomic Division Selects California Site

All atomic energy work of North American Aviation, Inc., will be centered at Canoga Park, Calif., by its new division, Atomics International. When all transfers are complete, the new headquarters will house approximately 1,000 personnel. The division is now building a nuclear reactor for industrial research under contract from Armour Research Foundation, Chicago, Ill., and another for medical treatment and research for the University of California at Los Angeles Medical Center.



TRUE NORTH-seeking gyro (l), employing bearing-less suspension, and HIG integrating gyro (r) are key inertial components.

Inertial Guidance: Part III

Component Design Challenges Industry

By Philip J. Klass

The search for smaller and more accurate gyros, accelerometers, integrators, computers and servo systems—the basic building blocks for inertial guidance systems—is one of the most challenging problems to be found in the avionics field.

Although all of these components have long been used in flight control and navigation systems, the degree of precision and accuracy required for inertial systems is several orders of magnitude beyond the previous state-of-the-art.

This explains why some of the nation's top engineers and scientists are searching for new ingenious mechanical and/or electronic inertial hardware. Simultaneously, they are painstakingly trying to root out even infinitesimally small errors in present inertial component designs.

Primary emphasis is on the problem of measuring and integrating acceleration and that of establishing an accurate spatial, vertical, or north reference.

Accelerometers

Acceleration measuring devices form the heart of all known inertial systems. At first glance, two possible design approaches suggest themselves for the accelerometer:

- **A pendulum,** supported by a pivot bearing. The problems here are that friction in the bearing dulls the device's sensitivity and, for large accelerations, the pendulum moves through an arc so that it begins to measure an unwanted component of gravity acceleration in addition to the desired linear acceleration of the vehicle.
- **Linear accelerometer,** consisting of a mass which is supported and restrained at opposite ends by springs. Here the problem in addition to friction, is one of obtaining a satisfactory spring gradient which will permit the device to measure a wide range of accelerations, varying as much as 100,000:1. If the spring is stiff enough to withstand high accelerations then creep and hysteresis errors become a problem.

During a recent talk before the New York section of the Institute of Radio Engineers, Dr. Bernard Litman of American Bosch Arma Corp. suggested the possibility of using a spring with low stiffness, and supplementing this with an electrical spring. Although Litman declined to elaborate, he reported that Arma has developed a small accelerometer which is capable of measuring accelerations as low as 0.000005G.

One possible application of this "electrical spring" technique involves the use of a small d.c. motor. A mass or pendulum is attached to the external motor case, and the case itself is supported by two low-friction bearings, as shown in the sketch above.

When the device is subjected to a linear acceleration, the external case and its mass will rotate slightly, as shown in dotted lines in the sketch.

If electric power is then applied to the motor's armature, of the proper polarity to cause the armature to rotate in the opposite direction to the movement of the external case, the armature will exert a torque which attempts to return the case to its original center position.

The greater the voltage applied to the motor armature, the greater its speed, and the higher the torque it will apply to the external case. If the voltage is increased until armature speed is sufficient to exactly return the case and pendulum to their center position, then *the armature voltage will be proportional to the linear acceleration* to which the device is being subjected. The device thus functions as an accelerometer, with the voltage applied to the motor armature being proportional to acceleration.

Because the case-pendulum is always returned to its center position as soon as it is subjected to an acceleration, it operates over a limited travel so that it measures linear acceleration and is not subjected to unwanted gravity effects.

Such an accelerometer might employ a set of electrical contacts or other pick-off arrangement which senses any displacement of the motor case-pendulum from center, and then applies a voltage to the motor armature, increasing its magnitude until the case returns to its center position.

Integrating Accelerometers

One promising hope for cutting weight and complexity of inertial systems is the use of "integrating accelerometers." These are devices whose output signals are proportional to vehicle velocity, instead of acceleration. Integrating accelerometers are under "extensive development and may supplant the simple accelerometer," Dr. Litman told the IRE meeting.

Several possible design approaches to an integrating accelerometer, cited by Dr. Litman, include:

- **Resonating vibrating device,** whose resonant frequency changes with the application of an acceleration force. Because deviation from resonant frequency varies directly with acceleration, it only is necessary to count the total number of cycles "lost or gained" over a time interval to obtain the integral of acceleration, or the change in vehicle velocity.
- **Unbalanced gyroscope,** whose unbalance makes it sensitive to acceleration. Any acceleration about the sensitive axis produces gyro precession (displacement) at a rate proportional to acceleration. This makes the total angle of gyro displacement proportional to the integral of acceleration—hence proportional to vehicle velocity.

Minneapolis-Honeywell is making such an integrating accelerometer, a spokesman told AVIATION WEEK. In the M-H unit, a single-axis-of-freedom gyro, with built-in unbalance, is mounted on a motor-driven turntable in such a fashion that rotation of the turntable causes precession of the gyro in the same way as does an external acceleration. (See cutaway, above.)

When the unit is exposed to an acceleration, the gyro precesses proportionately. This displacement causes a small gyro pick-off to generate a proportional signal which is amplified and applied to a motor. This starts driving the turntable and its gyro in such a direction as to generate counter-acting precession torques in the unbalanced gyro.

When turntable velocity and the precession torque it produces are sufficient to return the gyro to neutral, the turntable velocity is then proportional to the external acceleration being measured. The total displacement of the turntable from neutral is the integral of this acceleration, or vehicle velocity.

M-H makes the unit either with a helical potentiometer pick-off or a digital disk-type signal generator.

Integrators

The technique of integration is not new to the avionics designer. However, the extreme accuracy requirements of inertial systems tax the techniques previously used in airborne equipment, while the rigors of the airborne environment make it difficult to use techniques commonly employed in lab-type equipment, such as analog computers.

One of the most familiar types of integrators is an a.c. tachometer generator.

The tach generator normally is used in a circuit where it is caused to rotate at such a speed that it generates an a.c. voltage which always equals and cancels out the voltage (signal) it is intended to integrate, i.e.

Easy to Conceive, Difficult to Deliver

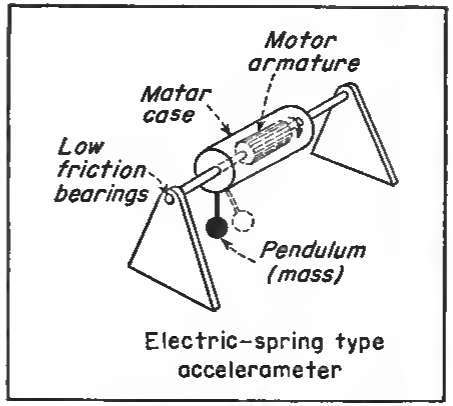
"An inertial guidance system is like a baby. It's easy to conceive, but difficult to deliver," according to one expert in the subject.

The fundamentals of inertial guidance are straightforward (if not simple) and at first glance the problem of designing a system does not seem too imposing. However, the problem of converting a paper design into practical hardware of reasonable accuracy, size and weight, hinges upon a company's ingenuity in designing extremely accurate inertial components—gyros, accelerometers, servo meters, computers and integrators.

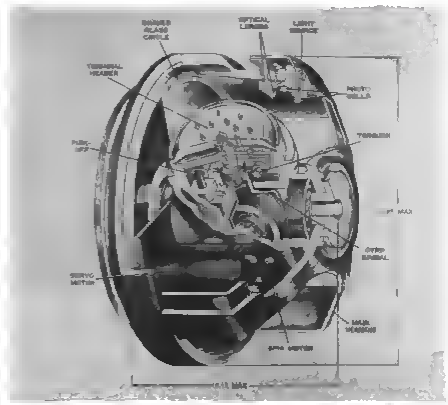
These must be designed to an accuracy which is a new experience for many firms yet must be sufficiently rugged to be able to operate in the difficult environment encountered in high-speed missiles and aircraft.

Once past this hurdle, the next problem is one of being able to manufacture the inertial components. At least a couple of firms reportedly have been trapped by the tricky requirements of their designers' developments.

Inertial components, the key to successful inertial guidance, are the subject of this third article in Aviation Week's four-part series.



ACCELEROMETER, shown schematically, employs a d.c. motor to provide "electric spring" with varying tension.



INTEGRATING ACCELEROMETER, made by Minneapolis-Honeywell, uses unbalanced single-axis gyro on servo-driven platform.

acceleration or velocity for an inertial system.

Under such conditions, the speed of tach generator armature rotation is proportional to its output voltage and hence to the signal to be integrated. Therefore, the total number of revolutions made by the armature over a period of time is proportional to the integral of the acceleration or velocity signal.

In actual inertial systems, the large range of acceleration signals which must be accommodated imposes the need for a much higher order of accuracy than in other types of airborne equipment.

Litman reported that Arma has developed a two-stage tach generator to overcome this problem. The two tach generators operate at different speeds and voltage ranges, with a suitable scheme for switching from one to the other.

Another analog-type integrator is the d-c integrating amplifier. This requires a high-gain amplifier, employing a feedback loop through a capacitor. The capacitor's leakage current, dielectric hysteresis and capacitance drift must be low to meet inertial system accuracies, Litman pointed out.

Digital-type integrators might also be used, particularly for accelerometers of the resonating type (described previously), where integration can be performed by counting impulses, cycles, or other "events."

With a digital integrator, almost any desired degree of accuracy can be obtained easily, whereas in analog type integrators, the required accuracy often seriously strains the state of the design and manufacturing art.

Gyroscopes

Two basically different types of gyros are finding application in inertial systems. There are strong differences of opinion between the proponents of each type as to which is best suited for the job. The two types are:

- **Displacement (free) gyro:** This is a refined, super accurate version of the conventional gyros long used in aircraft as artificial horizons, gyro-compasses and to provide signals to automatic pilots. It makes use of the gyro's inherent characteristic of attempting to maintain its spin axis fixed in space. The gyro is mounted on gimbals which give it two-degrees of freedom.
- **Integrating (HIG) gyro:** This post-war development of Massachusetts Institute of Technology's Instrumentation Lab is an adaptation of the familiar rate gyro. Both have only a single degree of freedom.

In a rate gyro, any displacement of the gyro and its gimbal about their free axis is opposed by springs in such a way that the greater the displacement, the greater the spring tension.

When such a rate gyro is mounted in an airplane or missile so that its input axis corresponds to the vehicle's yaw axis, any yawing rate of the vehicle will create a gyro precession torque proportional to this yawing rate. This in turn will cause the gyro to be displaced from neutral until the restraining spring tension just equals (and cancels out) the precession torque.

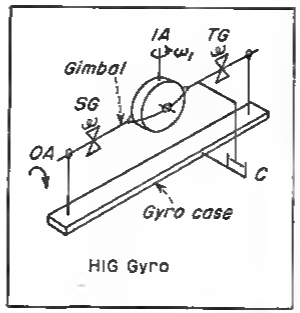
At such time, the total displacement of the rate gyro from neutral will be proportional to the airplane's yawing rate. A suitable pick-off on the rate gyro develops an output signal proportional to this displacement.

In the HIG (hermetically sealed integrating gyro), viscous damping replaces the spring restraint of the rate gyro. As a result, the restraining force exerted by the viscous damper is proportoinal to gyro precession rate, instead of being proportional to precession displacement, as in a rate gyro.

If a HIG gyro is mounted in an airplane in similar fashion to the previous example, yawing motion of the airplane will cause the gyro to develop a precession torque which (like the rate gyro) is proportional to the rate of airplane yawing. However, because of the viscous damping, this torque results in a gyro gimbal turning rate (instead of displacement) which is proportional to the vehicle's yaw rate.

Since the gyro is precessing at the same rate as the airplane is yawing, the integral of gyro precession rate over an interval of time (total gyro displacement) is proportional to the integral of airplane yawing rate over the same interval of time, and hence proportional to total airplane displacement. Thus, by sensing airplane yaw, pitch or roll rate and integrating it, the HIG gyro effectively measures the aircraft's total displacement about the same axis.

A schematic of an HIG gyro, shown below, illustrates the gyro's input axis (IA) which, when subjected to an



HIG Gyro

INTEGRATING gyro, shown schematically,

angular velocity ω_i, causes the gimbal to rotate. A small signal generator or pick-off (SG) measures total displacement angle through which the HIG gimbal moves. This is proportional to the total vehicle displacement. Viscous damping is shown schematically as C.

Attractive Characteristics

The HIG gyro has performance characteristics which make it extremely attractive for use in gyro stabilized platforms for inertial systems. These include:

- **Low drift.** Some of the larger gyros, such as the HIG-6, reportedly have random drift rates as low as 0.02 degrees per hour. This extremely low drift rate is due to the fact that the gyro is floated in a dense fluid which largely relieves the load on gyro gimbal bearings, greatly reducing the drift causing effects of spurious friction in the bearings.
- **Extremely sensitive.** Pick-offs used in HIG gyros are capable of detecting displacements of the gyro as small as 1/600 of a degree.
- **Wide range.** HIG gyros can be used to measure a wide range of angular rates. For example, the HIG-4 unit made by Minneapolis-Honeywell reportedly can integrate input rates over a range of 10^{-5} to 10 radians per second.

The number in the gyro designation (i.e. HIG-4, HIG-5, HIG-6) refers to the angular momentum of its flywheel. The HIG-4, for instance, has an angular momentum of the order of 10^7 gm-cm²/sec, while the HIG-5 has an angular momentum of approximately 10^8.

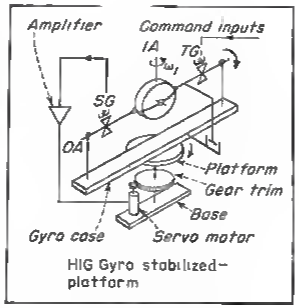
Until recently, it was thought that the larger the angular momentum, the lower would be the gyro's drift rate and the greater its sensitivity. Experience now indicates that this theoretical advantage of larger size is not always achieved in practice.

Smallest integrating gyro developed to date is the HIG-3, designed by Greenleaf Mfg. Co. Other major HIG gyro manufacturers include Minneapolis-Honeywell Regulator Corp. and Reeves Instrument Corp. and Kearfott Company.

When HIG gyros are used in an inertial stabilized platform, one gyro must be used for each axis which is to be stabilized. For example, a three-axis platform requires three HIG gyros.

To illustrate the operation of a HIG stabilized platform, consider the simplified single-axis platform shown above, right.

Assume that this platform is installed in an airplane and aligned with its yaw axis. Also assume that a gust suddenly changes the airplane's heading by, say, 10 degrees, in a counter-clockwise direction. As soon as the airplane starts to change heading, the HIG gyro will instantly sense the angular velocity and will be precessed about its gimbal axis at a proportional rate (see sketch).



STABILIZED platform (single axis) employing an integrating (HIG) gyro

This displacement will cause the HIG gyro pick-off (SG) to generate a signal which is amplified and then applied to a servo motor on the stabilized platform. The motor proceeds to drive the platform in a clockwise direction (opposite to plane's movement). This platform rotation will cause the HIG gyro to be precessed in the opposite direction. When the gyro spin axis has been precessed back to its original neutral position, the platform will have been rotated back through an angle of 10 degrees.

The signal from the pick-off will drop to zero, the motor will stop, and the HIG and platform will again be oriented in their original azimuth positions.

Feedback to the HIG

An important characteristic of the HIG for inertial system use is that it can also be precessed by application of an electric command signal, without any external rotational velocity being imparted to its case as in the previous example.

This is accomplished by means of a small torque generator (TG) built into the gyro (sketch above).

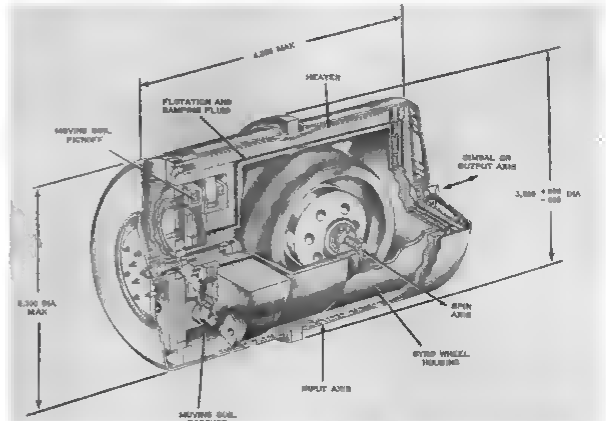
When a voltage is applied to this torque generator, it creates precession torques just as if the gyro case and platform were being rotated. If the HIG also is being subjected to an external angular velocity as well as having a signal applied to its torque generator, the two precession torques thus developed will add algebraically and the net torque will determine gyro gimbal displacement.

To illustrate the operation of a command signal input, assume that a HIG gyro is mounted on a single-axis stabilized platform as before and that the device is not subjected to any external angular velocity. Now assume that a signal is applied to the HIG torque generator. This will cause the gyro to start to precess at a rate proportional to the applied signal voltage. As soon as this happens, the gyro pick-off develops a signal which is amplified, applied to the servo motor and starts the platform rotating.

This angular rotation of the HIG's external case, the same as if the airplane itself were yawing, produces a counteracting precession torque within the HIG. When the system achieves balance, the platform will be rotating at a rate which is just sufficient to generate a precession torque which is equal and opposite to that developed by the torque generator. At such time, the stabilized platform's angular rate will be proportional to the input signal applied to the torque motor, and hence its total displacement over a period of time will be the integral of the input command signal.

As pointed out previously (AW Jan. 9, p. 42), in the 84-minute pendulum type of inertial system, that portion of the stable platform which mounts the accelerometers must be rotated at the same angular velocity as the carrying vehicle moves around the earth, or else must be rotated through the same angular displacement as the vehicle moves around the earth. This is necessary to keep the accelerometers continuously aligned in a horizontal position where they can not measure unwanted gravity acceleration.

If HIG gyros are used to stabilize the accelerometer mount, then the integrated output signal from an accelerometer, which is proportional to the vehicle's angular velocity, can be introduced into the HIG's torque motor. This will cause the HIG to precess and the accelerometer platform to rotate at the identical angular velocity of the vehicle about the earth, providing that system scale factors are properly selected.



CUTAWAY drawing of HIG gyro made by Minneapolis-Honeywell shows construction.

Displacement Gyros Gain

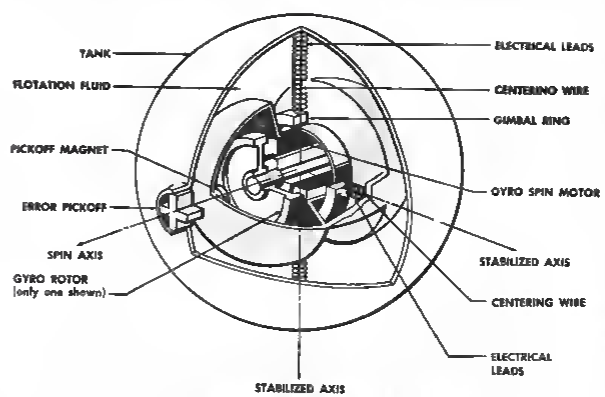
Although the HIG gyro's characteristics have led to its wide use in many inertial systems, recent developments in the older type of displacement gyro have led some companies, like American Bosch Arma Corp., to venture off the well-beaten HIG path.

Arma has developed a two-axis displacement type gyro, whose novel construction reportedly reduces gyro drift to 0.1 degree per hour. Arma has achieved this low drift rate by using complete flotation of the inner gyro element and substituting thin wire filaments for the gimbal bearings.

By floating the inner gyro element, its weight is shifted from the normal gimbal bearings or pivots to the liquid (except for a minute amount resulting from lack of perfect buoyancy). With the inner gyro element thus supported, it is only necessary to provide very thin wire filaments to keep the inner element centered, eliminating previously used bearings whose spurious frictions cause random drift.

A spherical shell containing the gyro motor and flywheel is attached to an inner gimbal by means of these thin filaments, and this gimbal in turn is attached to an outer shell by the same means (see sketch, below left).

The volume between the inner and outer shells is filled with the flotation liquid and the gyro element is then mounted on its own, two-axis stabilized platform, powered by two servo motors.



ARMA GYRO ELEMENT, floated in liquid, uses thin centering wires to keep floated element aligned to outer case, eliminating bearings whose friction causes drift.

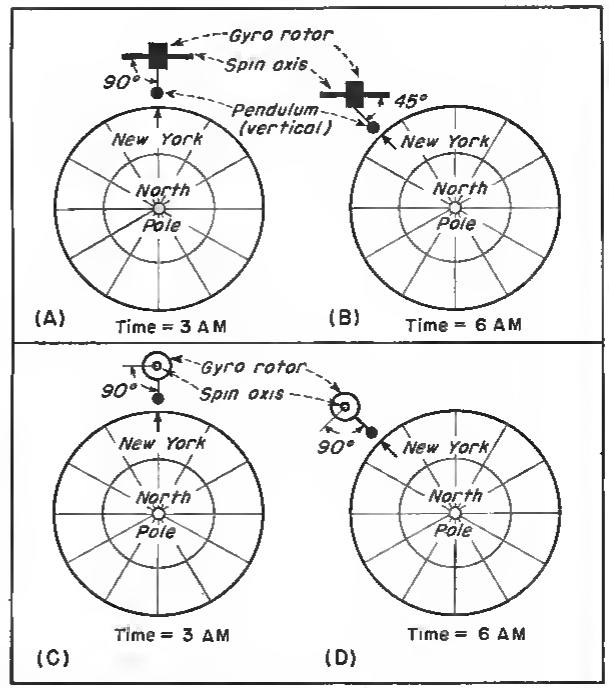
Substituting Known for Unknown

Any displacement of the outer case relative to the inner gyro element, which attempts to maintain its position fixed in space, results in a slight twist of the supporting wire filaments.

A pick-off located on the external shell instantly senses this displacement and generates an "error signal" which is fed to the stabilized platform servo motor. This causes the motor to rotate the platform and outer gyro shell, until the outer shell is again aligned to the inner element, thereby untwisting the supporting filaments.

Thus the platform always follows the gyro in angular position and functions as a power-driven space stabilized platform of high precision, Arma's Dr. Litman says. Consequently the supporting wire filaments always are maintained at essentially zero-angle twist.

Explaining the basic advantage of



PRINCIPLE OF ARMA'S NORTH-SEEKING GYRO is shown above. Gyro spin axis will depart from perpendicularity to the vertical due to earth rotation (top), unless gyro spin axis is aligned parallel to earth's spin axis (below).

this design, Litman says. "We've substituted a known spring torsion constant for unknown and unpredictable bearing frictions of conventional gyros."

It is safe to assume that the new gyro is being applied to some of Arma's inertial system developments, although company spokesmen decline to comment.

Arma has disclosed, however, that the new gyro design has been applied to a novel gyro-compass which seeks out true north, instead of aligning itself to magnetic north as in conventional aircraft gyro-compasses. This obviously is a very useful characteristic for an inertial system which must maintain its accelerometers oriented in a north-south and east-west direction.

Arma has built an airborne version of its north-seeking gyro-compass, weighing 23 lb. and measuring only 9 in. in diameter by 10¾ in. high, including all accessories and controls (see photo, p. 94).

Although new to aviation, the principle of the north-seeking gyro-compass has long been used in very large shipboard gyros, Arma says. The technique requires an extremely accurate, low-drift gyro, which until recently could not be achieved in a size small enough to permit its use in airborne vehicles, Litman says.

Another interesting aspect of the design is that earth's rotation, which is a source of error in an ordinary (unslaved) displacement gyro, is the thing which enables the Arma unit to seek out true north.

Principle of Operation

To illustrate the operation of the north-seeking gyro, assume that a gyro were placed on a table located on the earth's equator, on a north-south meridian running through New York. Suppose also that the gyro spin axis is aligned so that it points east-west and simultaneously is horizontal—at right angles to a pendulum indicating the (vertical) direction of gravity, as shown in sketch above.

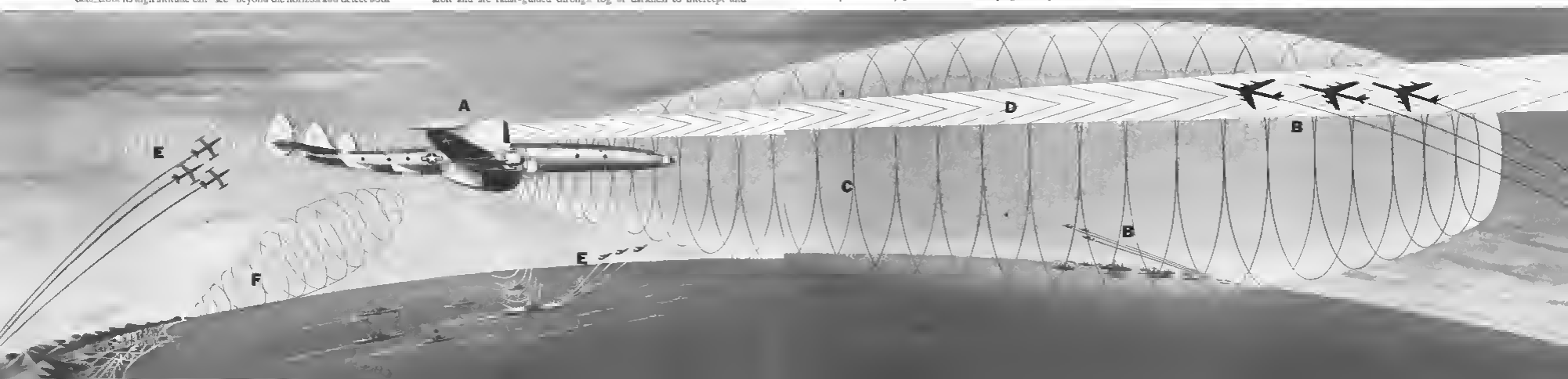
Three hours later, when the earth has rotated through an angle of 45 degrees, the gyro spin axis will no longer

New U.S. Concept for

TOTAL DEFENSE

In this age of awesome airborne nuclear weapons, a vast umbrella of airborne electronics will safeguard our nation against sneak attack

BELOW—A WEAPONS SYSTEM IN ACTION An electronics-laden Super Constellation early warning plane (**A**) patrolling our outermost defense perimeter hundreds of miles from our shores and borders, from its high altitude can 'see' beyond the horizon and detect both high-flying and low-flying enemy aircraft (**B**). Using its powerful search radar (**C**) and height-finder radar beam (**D**) to pinpoint position of invaders, the patrol plane alerts our interceptors (**E**) which swarm aloft and are radar-guided through fog or darkness to intercept and destroy the attackers with high-speed rockets or missiles. Any enemy aircraft penetrating our barrier patrol areas would be detected by shore-based radar stations (**F**) and Ground Observer Corps outposts continuously manned by patriotic civilians helping to keep our nation free.



LEFT—EARLY-WARNING RADAR PATROL. Designated the WV-2 by U.S. Navy and EC-121 by USAF these radar-domed Lockheed Super Constellations carry six tons of electronics and a 31-man crew. Super Constellations are ideal for this duty because of their famed all-weather stability and extremely long range.

ABOVE—ROCKET-FIRING STARFIRE INTERCEPTOR. First of the almost-automatic all-weather interceptors, the Lockheed F-94C Starfire is an example of Lockheed's leadership in the design and development of airborne electronics. This deadly defender and other interceptors will soon be supplemented by—

Farsighted Pentagon planning and recent amazing technological developments by U.S. science and industry are rapidly making our nation's TOTAL DEFENSE system the most formidable in all history.

Lockheed's role in implementing our new Weapons System concept and in Systems management, is an important one. Thousands of Lockheed military aircraft, of *nine* widely different types, are already in service. Other advanced planes, missiles and electronic guidance devices are in production, undergoing tests or on the drawing boards at Lockheed. And Lockheed's pioneering leadership in design and development of airborne electronics will continue to contribute heavily to TOTAL DEFENSE.

STILL-SECRET F-104 SUPERSONIC JET FIGHTER (Photo not yet released.) A high-ranking USAF officer said of the F-104: "This is a fighter pilot's dream. We feel confident that it is the fastest, highest-flying fighter in the air, anywhere."

THREE PHOTOS AT LEFT show crew members of Super Constellation early-warning plane at work. (Top) Navigator plotting a fix, (center) observers at radar consoles plotting altitude, speed and course of unidentified aircraft, (bottom) fighter-director charting position and path of approaching aircraft.

Lockheed

AIRCRAFT CORPORATION

California Division, Burbank, Calif.
Georgia Division, Marietta, Ga.
Missile Systems Division, Van Nuys, Calif.
Lockheed Air Terminal, Burbank, Calif.
Lockheed Aircraft Service, Burbank, Calif.

LOOK TO LOCKHEED FOR LEADERSHIP

A CAREER IN MILITARY AVIATION ASSURES A FINE FUTURE FOR YOUNG MEN. OVER 17? SEE YOUR NAVY OR AIR FORCE RECRUITING OFFICER.

be at right angles to the pendulum (Fig. B). Because the gyro maintains its position fixed in space while the earth rotates, the angle between the gyro spin axis and the pendulum would be equal to the earth's rotation, or 15 degrees (assuming no gyro drift).

If, however, the gyro's spin axis is initially aligned along a longitude meridian (true north), as shown in Fig. C, its spin axis will always remain at right angles to the pendulum (vertical) despite rotation of the earth, as shown in Fig. D.

Thus, the spin axis of a gyro-compass will appear to "drift" from perpendicularity to a pendulum, unless its axis is aligned parallel to the earth's spin axis (pointing along a longitude meridian). The magnitude of this drift from the vertical will vary as the cosine of the latitude at which the gyro-compass is located. For example, the drift angle will be a maximum at the equator, decreasing to zero at high latitudes. (For this reason the north-seeking characteristics are usable only up to latitudes of about 80 degrees.)

Two-Axis Platform

The north-seeking gyro is mounted on a two-axis stabilized platform, with the gyro aligned so that one axis measures azimuth (heading) angle while the other measures tilt angle of the gyro relative to the vertical. Signals from the gyro pick-offs keep the stabilized platform aligned relative to the gyro's spin axis as previously described.

A damped pendulum hangs below the stabilized platform continuously indicating the average position of vertical (gravity).

At such times as the gyro's tilt axis is parallel to the earth's spin axis (pointed north), the stabilized platform itself will be at right angles to the pendulum. If the gyro itself has extremely low random drift, then any deviation of the gyro's spin axis from perpendicularity to the pendulum results from the effect of earth's rotation—an indication that the gyro spin axis is not perfectly aligned parallel to the earth's spin axis and hence not pointing to true north.

When this happens, the pendulum generates a signal which causes the stabilized platform to rotate back to a position of perpendicularity to the pendulum, and this causes the gyro spin axis to be precessed back into alignment with the earth's spin axis.

Vehicle Velocity Must be Known

One problem arises when the gyro compass is used in a moving vehicle, because the gyro is unable to distinguish vehicle velocity from earth's rotation, and senses the vector sum of the two. Thus a high vehicle velocity in the

north south direction will cause the device to "think" that the earth's spin axis has been tipped slightly, unless suitable compensation for vehicle velocity is introduced.

For ground vehicles such as tanks (for which the unit originally was developed), this is relatively easy.

For high-speed aircraft, the problem is more difficult, since the plane's **ground velocity** is what is needed. If the device functions as part of an over-all inertial system, then of course the vehicle's velocity is known and suitable corrections can be introduced.

If the device is used by itself, it is possible to obtain ground speed from a Doppler radar, or it could be calculated approximately from airspeed.

Arma reports that its north-seeking gyro compass is being evaluated by Army Aviation for helicopter use as well as in a Military Air Transport Service plane. The company reports average gyro-compass drift of 0.1 degree per hour, and average accuracy of ¼ degree in establishing a true north heading.

Accurate Computers

Analog-type computers capable of performing spherical trigonometric computations of the type required for a navigation system have long been used in aviation. However, here again the extreme accuracies needed for practical inertial systems go considerably beyond those required for previous types of applications.

The obvious solution to this problem of obtaining greater computation accuracy is to go to digital-type computers, where almost any desired degree of accuracy can be obtained with little additional penalty in size, weight and cost.

Typical of the present advanced state of airborne digital computer art is the digital differential analyzer developed by North American Aviation. The 93-integrator computer weighs only 125 lb., occupies 3 cu. ft., and consumes less than 100 watts of power.

Added advantage of digital computers, particularly for aircraft inertial systems, is that the computer conceivably could be used to simultaneously solve other than navigation problems, i.e. bombing, fire control, etc. Present digital computers operate so fast that it is possible for one to perform its inertial navigation computations in a fraction of a second, switch over to the bombing problem, then back to the inertial navigation problem.

These advantages explain why many designers of new inertial systems are making use of digital computer techniques.

Servo Systems Important Too

Despite the emphasis on gyros and accelerometers, the design of servo systems capable of providing accurate stabilization of the accelerometer platform has raised imposing problems.

Obviously it does little good to come up with gyros capable of detecting tiny deviations from a spatial reference unless the servo systems which they feed are capable of rapid response to such signals. These servo systems must also be capable of keeping the platform stabilized despite rapid changes in vehicle attitude and/or heading. Inertial systems demand servo systems with very low "tracking" (acceleration and velocity) errors.

Spurred by such demanding requirements, North American Aviation's Autonetics Division, for example, has developed entirely new techniques of servo system analysis and design.

One Way Out

Because of the extreme accuracy required in a pure inertial system, the components often prove difficult and costly to manufacture to the desired accuracies. Also, a pure inertial system with accuracy sufficient for long mission vehicles may weigh hundreds or thousands of pounds.

There is an interesting alternative. That is to use a "hybrid" system which employs both inertial and other navigation techniques, such as Doppler or other types of radar, or an automatic star tracker.

Several of these hybrid inertial systems, which greatly ease the accuracy required of inertial components, will be described in the concluding article of this AVIATION WEEK series.

Expansions, Changes In Avionics Industry

The Ramo-Wooldridge Corp., Los Angeles, has taken options on 800 acres of land in Denver for the construction of a manufacturing facility, confirming an early AVIATION WEEK report (Aug. 29, 1955, p. 62).

The firm emphasizes that selection of the Denver site "is not expected to have any relation to activities known to be planned by any other companies for the Denver area." This appears to be a reference to recently announced plans of the Glenn L. Martin Co. to build a Denver facility, reportedly for its intercontinental ballistic missile project.

Other recently announced avionics industry expansions include:

- **Spencer-Kennedy Laboratories, Inc.**, Boston, maker of filters and high-speed oscilloscopes, has moved to a new facility on Soldiers Field Road.
- **Clevite Corp.**, Cleveland, has acquired full ownership of Transistor Products, Inc., Waltham, Mass., and changed its name to Clevite Transistor Products. Clevite purchased a majority interest in the firm early in 1953 as part of its expansion into the electronics field. Dr. R. B. Holt, founder of Transistor Products, continues as president.
- **Radio Receptor Co.**, Brooklyn, is expanding its semi-conductor manufacturing facilities by 24,000 sq. ft. Company expects to increase its selenium rectifier production by 40% in 1956.
- **Narda Corp.**, maker of UHF and microwave equipment, has moved to new expanded facilities at 160 Herricks Road, Mineola, L. I., N. Y.

FILTER CENTER

▶ **Wanted 4 Million Tubes**—Army Signal Corps plans to buy 4 million electron tubes during coming year for Air Force and Army use. More than 280 different tube types will be procured. Prospective suppliers can obtain additional information on tube procurement by writing Commanding General, Signal Corps Supply Agency, 225 So. 18th St., Philadelphia 3, Pa.

▶ **PAA Buys RCA Radar**—Pan American has ordered a million dollars worth of RCA airborne radar for its new fleet

of 45 jetliners. The action raises PAA's total airborne radar orders for its fleet of 129 DC-6s, DC-7s and jets to $3 million.

▶**GE Eyes Computer Field**—General Electric has set up a new industrial electronics laboratory and an new industrial computer section in its recently reorganized Electronics Division (AW Dec. 5, p. 9). Although it isn't generally known, GE seriously considered entering the digital computer business in 1947, but decided against going into competition with major business machines companies, which were customers for other GE products. Striking growth of the market for digital computers and their use in plant automation apparently has prompted GE to reconsider.

▶**New RCA Two-way SSB Radio**—Radio Corporation of America has announced a new two-way simplex single-sideband high-frequency communications set suitable for either fixed or mobile use. RCA says it has demonstrated its new SSB system to the Civil Aeronautics Administration, and that the Coast Guard has obtained one for evaluation.

▶**Avionics Papers Wanted**—The 1956 Dayton Conference on Aeronautical Electronics is seeking technical papers for presentation at annual meeting, May 14-16. Write C. E. Doyle, P. O. Box 621, Far Hills Branch, Dayton 9, Ohio.

Panagra Tests VORs—Two omnirange stations have been installed in Argentina, one near Buenos Aires, the other at Malargue in the Andes foothills, to enable Panagra to evaluate their suitability for improving navigational facilities across the Andes. One VOR was manufactured by Federal Telecommunications Laboratories, the other by Wilcox Electric. Panagra says that pilot reports on the new facilities have been "uniformly enthusiastic."

NEW AVIONIC PRODUCTS

Semi-Conductors

a **High-power silicon rectifier**, broad-area type, comes in cells rated at 100 peak inverse volts, 14 amp half-wave. Cells can be stacked to meet desired circuit requirements. Silicon rectifiers have efficiency of over 99%. Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N. J.

a **Silicon transistors**, PNP, for high temperature use are now available in production quantities in three new

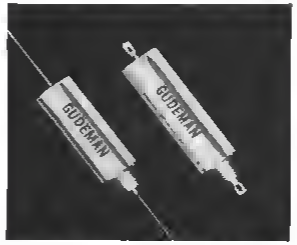
types. The CK790 and CK791 are designed for audio and low RF applications, with collector dissipation of 50 mw. at 135C. The CK793 is a low-noise transistor for low-level preamp circuits. Application data is available from Technical Information Service, Raytheon Mfg. Co., 55 Chapel St., Newton 58, Mass.

• **Silicon power transistor,** NPN Type 970 rated for maximum collector dissipation of 3.5 watts at 100C, or 8.75 watts at 25C. New unit is suitable for output stages of servo amplifiers. Type 970 is hermetically sealed in a disk

approximately ½ in. in dia. x ½ in. high, with a heat sink mounting plate measuring about ¾ in. x 1¼ in. Bulletin DLS 571 gives application data. Texas Instruments Inc., 6000 Lemmon Ave., Dallas 9, Texas.

Components & Devices

• **Miniature "feed-through" capacitors,** using paper dielectric, for use in RF interference suppression, come in two types. Type 271 has operating temperature range of —55 to 85C. Type



272 has range of —55C to 125C. Standard capacitance tolerance is 20%, power factor is less than 1% at 1,000 cps, 25C. Units reportedly meet MIL C-25A. Gudeman Co., 340 W. Huron St., Chicago 10, Ill.

• **Voltage sensitive capacitors,** ceramic types LVSR and LVSE, have their capacitance lowered by as much as 60% with the application of d.c. voltage up to 200 volts. Type LVSR has maximum sensitivity at room temperature while the type LVSE has maximum

Cessna's CH-1 Performs Brilliantly In Army Tests— First helicopter to land on Pike's Peak

History was made September 13, 1955, when Cessna's new CH-1 helicopter landed on the summit of 14,110-ft. Pike's Peak. The event marked the first time a helicopter had landed on the famous peak and climaxed a series of Army evaluation tests for the highly functional CH-1.

Earlier that same day, the all-metal CH-1 flew to an altitude of 17,600 ft. over Colorado Springs. Then, after landing on Pike's Peak, the new helicopter, with three people aboard, hovered above the peak before flying back to the originating point of the Army tests at Camp Carson, Colorado.

The test results backed up Cessna's confidence in its new CH-1. It can climb from sea level to 10,000 ft. in less than 10 minutes. Over 120 m.p.h. speed gives the CH-1 highest top speed of any helicopter certified by CAA.

Cessna engineers and designers planned the new helicopter for maximum efficiency, low operating cost. The simplified mechanical detail of the revolutionary transmission, rotor assembly and drive system eliminates many extra parts requiring lubrication and service, cuts down on maintenance costs.

Its engine location—in the nose of the fuselage—is another example of the CH-1's functional design. Mounting the engine forward results in important savings in installation and servicing time, provides extra cargo, or passenger, space.

The excellent test performance of the CH-1 climaxes an intensive research effort by Cessna during the past three years. Military requirements call for the kind of performance the CH-1 can deliver. It is an important step forward in helicopter aviation. Cessna Aircraft Co., Wichita, Kansas.

Cessna

sensitivity at 70C. Both measure ⅜ in. dia. x ½ in. long, and come with radial leads. Capacitance values range from 300 to 100 mmfd. Mucon Corp., 9 St. Francis St., Newark 5, N. J.

• **Sub-miniatured pot**, Type 101A, measures only ½ in. in dia. x 0.43 in. long, making it smaller than the shaft of a conventional pot entiometer. The tiny trimmer pot is available in standard resistances of 680 to 6,800 ohms, with other values on special order. Pot is rated at ¼ watt at 20C. Wiper travel is 320 deg. Carter Mfg. Corp., 23 Washington St., Hudson, Mass.

• **Power connector** has polarizing screw lock feature to provide positive locking of plug and receptacle and to simplify separation of the plug and receptacle. Series E/Z 16 is available with 12, 18, 24 and 34 contacts with solder cup for

#16 AWC wire or solderless wiring taper pin. Connector comes in a choice of several molding compounds. Electronic Sales Div., DeJur-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.

Test Equipment

• **Digital frequency meter**, Model 5571, gives direct read-out of any frequency from 1 cps. to 42 mc., or up to 515 mc. with a VHF converter. Accuracy is ±1 count ± crystal stability which is one part in 10^7, short term. Device can be used to actuate a read-out printer. For application data, write to Dept. NR 31, Berkeley Division, Beckman Instruments, Inc., 2200 Wright Ave., Richmond 3, Calif.

• **Dynamic voltage tracer** is for accurate recording of the dynamic characteristics of magnetic devices and components. Device also can be used to test semi-conductors and other non-linear components. Overall evaluation accuracy is quoted at better than 2%, with phase angle accuracy better than 1%. Bulletin No. 104 gives application data. Hamner Electronics Co., Inc., P. O. Box 531, Princeton, N. J.

CAB Report on PNYA Rooftop Crash

Helicopters Get New Cable Disconnect

A Bell Helicopter, model 47G, N 942B owned and operated by the Port of New York Authority, crashed during takeoff from the heliport atop the Authority's building, 111 Eighth Avenue, New York, New York, about 1515 (Eastern Daylight Time), July 13, 1955. The aircraft was destroyed by impact and ensuing fire and both occupants, Pilot Marcel Chevalier and Passenger Arthur Truss, were seriously injured.

Pilot Chevalier landed the subject aircraft at the heliport about 1450 EDT. The engine was stopped to permit his two passengers to examine the helicopter. They did so, and left for an elevator to the building below. Passenger Arthur Truss then boarded with an aerial camera. The pilot plugged in to the helicopter an external power line and started the engine.

The purpose of this flight was to take photographs at Staten Island in the Port of New York Authority area, of projects in connection with the work of the Authority. Both the pilot and the passenger photographer were employes of the Authority.

Takeoff was toward the southwest into a wind of about 16 miles an hour. Both occupants had their safety belts fastened. Seconds later, when the helicopter was about 10 feet high, it nosed down and its rotor blades struck the side of the building at the edge of, and immediately beyond, the heliport. It then turned over and fell, crashing in an inverted position against the west wall, and at the edge of the heliport.

The tail rotor and associated components continued beyond the wall and fell to Ninth Avenue, 16 floors below, causing slight damage to one automobile and superficial injury to one pedestrian. The main wreckage balanced precariously at the edge of the heliport as fuel burned violently.

The fire burned through the webbing of both safety belts, allowing both occupants to fall a few feet to the tiled roof, both landing on their heads. Building employes rushed in, dragged both from the fire, and extinguished flames on their clothing.

Meanwhile police, hospital, and fire fighting agencies had been alerted. Personnel from all three were at the scene almost immediately as the site was in a congested area of Manhattan. The fire was extinguished with negligible damage to the building and pilot and passenger were taken to nearby St. Vincent's Hospital, Seventh Avenue and Eleventh Street, New York City.

INVESTIGATION

External power supply was used for starting. It is commonly used in helicopter operation as individual flights are often too short to allow recharging of the helicopter's battery.

It was ascertained that the auxiliary battery boost cable used for starting, had not been disconnected from the helicopter prior to takeoff. This cable is 32 feet 9 inches long and consists of two conductors of No. 6 wire using a standard AN 2552-2A Cannon plug. It is rather large in cross sectional area, strong in tension, and durable.

The external power supply receptacle was installed on the helicopter at the Bell factory, with CAA approval. It was located at station minus 12 on the left side (just rear of firewall and pilot seat) and faced outward horizontally.

Almost immediately after takeoff a right turn was made to the west toward the nearby Hudson River as a safety measure.

(the helicopter was fitted with pontoons). When the slack in the external power cable was used up, the Cannon plug did not pull free because the direction of pull was at a large angle to the axis of the plug. Consequently, the helicopter was abruptly snubbed, resulting in the nose dropping and the aircraft crashing. The pilot had sensed this drag only an instant earlier and there was no time to remedy the situation. A witness on the street below saw the helicopter "quiver" before it crashed.

The heliport is 376.50 feet above mean sea level and is privately operated by the Authority for its own use. The landing area is 40' x 45' and is surrounded by a heavy mesh wiring approximately 5' wide and at an upward angle of 15 to 20 degrees. Marking is conspicuous with a yellow center circle 20 feet in diameter with a white border one foot wide and white diagonal lines one foot wide.

Incident at La Guardia

Pilot Marcel Chevalier possessed a CAA airman certificate No. 98783-41 with commercial airplane, single- and multi-engine land and sea, instrument, flight instructor, aircraft, and helicopter ratings. His last CAA physical examination was passed on January 2, 1955. His total flying time to July 1, 1955, was 5,427.50 hours, of which 3,561.55 had been in helicopters. He had flown 3.50 hours during the day of the accident and had previously rested for a period of 18.40 hours.

Mr. Chevalier had made approximately 4,000 takeoffs and landings without incident at the subject heliport. On one other occasion he had started takeoff (at La Guardia Airport) with the starting cable still attached but the plug pulled free before any damage occurred.

Investigation disclosed further that from May 1951 until this accident there had been over 7,500 helicopter takeoffs from, and landings on, the subject heliport. All had been uneventful.

Gross weight at takeoff was 2,097 pounds as against a maximum allowable of 2,350 pounds. The location of the center of gravity, which is critical and extremely important on helicopters, was within prescribed limits. A breakdown of the gross weight follows:

Empty weight	1,524	pounds
Photographer	170	"
Aerial camera	35	"
Pilot	140	"
Gas (35 gallons)	210	"
Oil (10 quarts)	18	"
	2,097	

Weather at the approximate time of the accident was reported by the U. S. Weather Bureau at New York as follows: Cumulus clouds 4 (approximately 5,000 feet), visibility 9 miles, relative humidity 39 percent, wind south 16 m.p.h. The Port of New York Authority has arbitrarily limited the use of their helicopters at this heliport to winds of less than 30.35 m.p.h., or 25 m.p.h. if gusty.

Maintenance on the helicopter had been thorough and in full compliance with all manufacturer's and CAA directives. Records indicated all periodic inspections had been meticulous. The total operating time was 1,089 hours, of which 89 hours had been since the last 100 hour inspection on

SAFETY

June 14 1955 Individual components of the helicopter had been used well within their specific limits The Port of New York Authority had set high operational standards for their helicopters as well as for the experience levels of pilots and mechanics

No Malfunction

Examination of the wreckage yielded nothing to suggest that there had been any malfunction of any sort and the pilot testified that there had been none

The Port of New York Authority helicopters do not carry a takeoff checklist and are not required to But it is the established custom for the pilot and his exclusive responsibility to handle the plugging in of the auxiliary power cable before starting the engine and to disconnect it before taking off

This is so because as a safety measure no persons are allowed on the confined area of the heliport while a helicopter is there with rotor turning In this instance the pilot forgot to disconnect the cable and said so to Board investigators

ANALYSIS and CORRECTIVE ACTION

This accident does not present conditions of any sort

Immediately after this accident engineers of the Port of New York Authority devised a quick and automatic release fitting cable plug intended to prevent similar accidents This new installation was soon applied to the Authority's sister helicopter and at all their landing sites

On the new installation the receptacle on the helicopter faces vertically down The plug is inserted vertically upward A weight of several pounds rests on the surface of the heliport and is attached by a small chain with a few inches of slack to a quick-disconnect arm on the plug

Should the disconnect operation be forgotten and the helicopter rise only these few inches the weight trips the arm and the plug is forcibly ejected This type of device is known generically as a mouse trap mechanism

FINDINGS

On the basis of all available evidence the Board finds that

1. The helicopter and its pilot were currently certificated
2. Weather was not a contributing factor
3. There was no malfunction of the helicopter or of any of its components
4. It was the pilot's sole responsibility to disconnect the starting cable
5. The resulting snubbing by the cable unbalanced the helicopter causing loss of control

PROBABLE CAUSE

The Board determines that the cause of this accident was the pilot's oversight in not disconnecting the starting cable causing the aircraft to crash

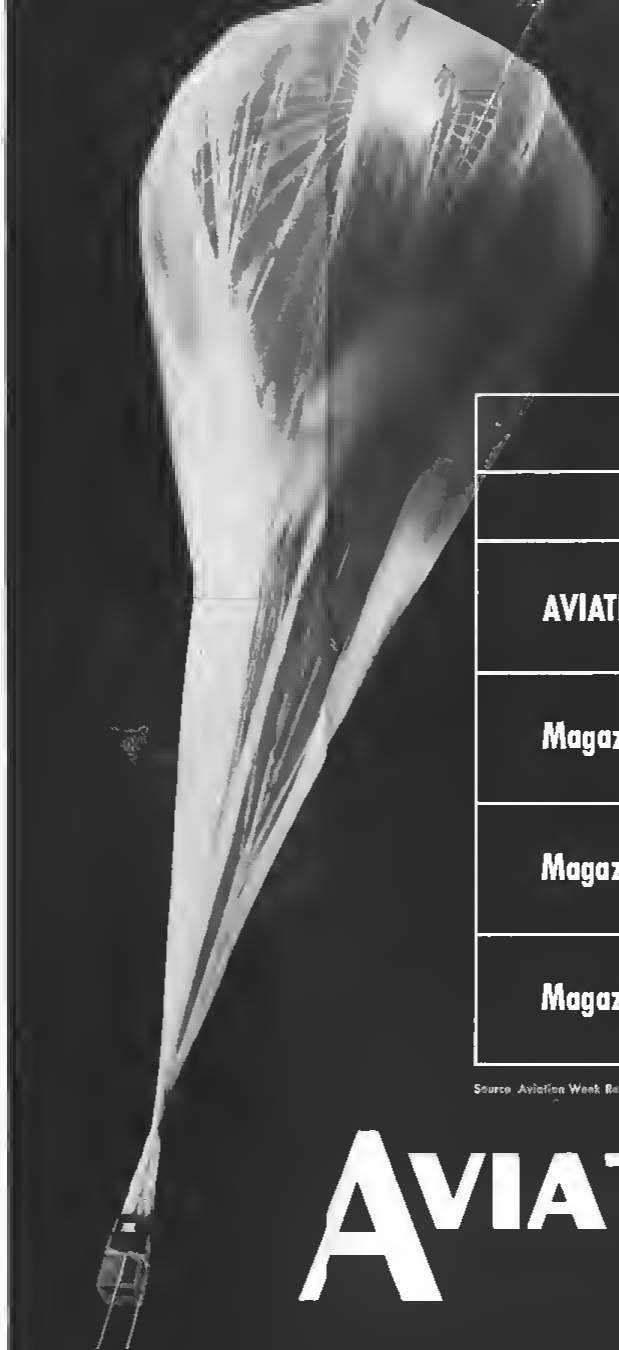
By the Civil Aeronautics Board
ROSS RIZLEY
JOSEPH P ADAMS
JOSH LEE
HARMAR D DENNY

(Chan Gurney, Member did not participate in the adoption of this report)

1955 Aviation Week Linage Sets All-Time Space Record

AVIATION WEEK carried 4,298 pages of advertising in 1955 . . . gained 778 pages over 1954's record 3,520 . . . a total advertising volume and gain marking an all-time high in aviation publishing! Built on top of the largest previous yearly volume in aviation publishing, AVIATION WEEK's new 1955 record exceeds the next-ranking publication in advertising volume by more than 2,000 pages, in gain far exceeds the total advertising gain of the 2nd, 3rd and 4th-ranking aviation business publications combined. AVIATION WEEK is the only aviation publication to rank among the top 20 U.S. leaders (including consumer magazines) in advertising space.

This unbroken, ever-growing trend to AVIATION WEEK proves more and more buyers of aviation advertising are recognizing that readership and selling power invariably "keep company" with paid circulation. Key men throughout the multi-billion-dollar aviation industry are willing to pay $6.00 a year, cash-on-the-line for AVIATION WEEK because they depend on AVIATION WEEK's penetrating, accurate, up-to-the-minute reporting of aviation's swift-paced technical progress. Advertisers have learned through experience that there is no substitute for AVIATION WEEK's readership among the engineers, management men, scientists, military and government officials who guide the destinies of world aviation.



BOX SCORE OF AVIATION ADVERTISING

	1955	1954	Gain
AVIATION WEEK	4298	3520	+778
Magazine "A"	2213	1877	+336
Magazine "B"	1449	1142	+307
Magazine "C"	566	774	−208

Source: Aviation Week Research Dept.

AVIATION WEEK

A McGRAW-HILL PUBLICATION

Airlines Face First Major Pilot Shortage

Major carriers engaged in recruiting drive as largest expansion program gets under way.

By Evert Clark

Washington—U S airlines today are facing the first pilot shortage in their history, and new route awards and new equipment promise to push demand ever farther ahead of supply.

Airlines, now engaged in their greatest expansion program, employ a record number of pilots and co-pilots—more than 9,000.

Almost every major line is recruiting now to fill its needs for piston-engine equipment already on hand or due to be delivered in the next few months.

They are unwilling to discuss what the situation is likely to be when turboprop and turbojet transports, already on order, begin to be delivered in 1958 and 1959.

The short supply of qualified pilots with experience in multi-engined planes also poses a threat to mobilization.

Survey Results

Commerce Department's Defense Air Transportation Administration estimates it would be 4,000 transport pilots short of its mobilization requirements if war began tomorrow.

The seriousness of the situation is apparent from a survey of major airline recruiting programs.

• **United Air Lines** now has 1,500 pilots. It hired 270 last year and wants 330 more this year.

• **Pan American World Airways**, with 1,540 pilots, has been hiring since last June for the first time in several years. It added 190 pilots in 1955 and foresees a need for "some" more in 1956 just to fill its needs for new four-engine piston aircraft. This does not take into account the pilots PanAm will need for the 45 turboprop and turbojet transports it has ordered.

• **Trans World Airlines** now has 1,300 pilots and "will be doing some recruiting for the next several months."

• **Eastern Air Lines**, with 1,250 pilots, wants 180 to 200 more this year just to fly equipment which will be delivered this year. Eastern's future needs give a good example of what most major airlines will be up against in the next few years. Eastern expects more new piston-engine equipment to come in late in 1957 and early in 1958. More will be delivered from the fall of 1958 through the fall of 1959. Delivery of some 60 turboprop and turbojets will start in the spring of 1959.

• **American Airlines**, which has about 1,500 pilots now, says it sees "no shortage" of new prospects, but says it will continue to recruit pilots throughout 1956.

The airlines agree that their major source of supply has been and will continue to be former military pilots.

At the end of World War II there were a large number of ex-military pilots, but this supply has been used up.

The Korean War produced a few more pilots than the average peacetime year. But these, too, apparently have been absorbed by the industry already or have gone into other fields.

Other Shortage Factors

These other factors also affect the supply of pilots.

• **The armed services** are trying harder than ever to keep the same pilots the airlines are trying to recruit.

• **Business flying and agricultural flying** are expanding rapidly, along with airlines traffic. While neither hires many pilots away from the airlines, both represent some competition for the "raw material."

• **Age is becoming more and more a problem.** Civil Aeronautics Administration figures show there are more airline pilots in the 35 to 39 age group than in any other. The job for airlines is to find candidates in the ideal age range from 21 to 28. United summed it up this way: "As for age, the men who learned to fly in World War II are rapidly passing out of the acceptable ranges while those within the 21-28 age bracket are flying for the military."

Thin Market

Some lines now take pilot candidates slightly younger and slightly older than they did several years ago. There may be more shifts both in age limits and in the number of hours of experience required as candidates become more scarce.

"The market is going to be rather thin this year," an airline personnel director told AVIATION WEEK. "We are rather concerned about it to be quite frank.

"We have had quite high requirements in the past. Whether we are going to have to lower them I don't know," he said.

One chief pilot, whose line is recruiting heavily this year, said he thinks there may be enough pilots around to fill all airlines' needs—but not enough excellent first-class pilots."

"By mid-year, all of us may have to lower our requirements," he said.

May Relax Requirements

Several lines said they have considered dropping the requirement that applicants have instrument training, and give that training themselves, as United Air Lines does now.

Several also said they have even looked into the possibility of taking young men who have no flying experience at all and training them from the ground up. But they all found that the great expense involved and the risk that a man might get his training and then leave the airline make this idea wholly impractical.

There is widespread concern both in Government and industry over the way interest in aviation among young people has lagged behind the demand for skilled personnel—pilots, co-pilots and engineers, mechanics, meteorologists and radio operators as well.

The Aeronautical Training Society, which represents 100 of the larger flying schools, said the number of flight and ground schools in the country dropped steadily from 3,078 in 1947 to 957 last year.

Certificate Gain

ATS says the 1947 figure was somewhat "inflated" by the number of schools opened right after World War II to train veterans under the veterans schooling legislation. It says the 1955 figure is "more realistic," representing "the hard core" of schools.

The number of ground schools increased slightly last year for the first time since 1950. ATS hopes this is a sign that the decline is over and that an upswing is beginning.

But it says some of the best schools have closed in the recent past, and the decline "was not encouraging."

There are some encouraging signs for the future. The issuance by CAA of student, private and commercial pilot certificates, which had been staying below a 1951 peak, is increasing again.

All three showed a slight increase in the first nine months of 1955 over the same period in 1954.

Efforts Increased

But along with that, the certification of airline transport pilots—which hit a high in 1953—dropped 25% in 1954. For the first nine months of 1955 they were down 5% from the first nine months of 1954.

A number of organizations—including the airlines, the U S Office of Education, the National Aviation Education Council and the armed services—are doing all they can to encourage more young men to fly.

The President's recent Air Policy Report calls for more effort along those lines, both for civil and military reasons.

The House Interstate and Foreign Commerce Committee has before it a bill to create, through a system of contests, programs and scholarships, a reservoir of civil personnel trained in all phases of aviation to meet civilian needs and to provide standby personnel for needs of national defense."

But new material going into one end of the supply line takes a long while to come out the other end. Demand for qualified airline pilots apparently will run ahead of supply for considerable time to come.

Meanwhile, the Government, through its military flying programs—will continue to train most future airline pilots for some time to come.

Retention of Pilots is Military Problem

The military's pilot problem is retention of trained personnel.

With the help of its ROTC program for instance, the Air Force finds it gets as many men into pilot training as it needs.

Keeping them there once they have served their obligated time is difficult. The retention rate among regular cadets is high. But USAF estimates it keeps fewer than one third of its college trained ROTC fliers.

A trained pilot can shop around for civilian jobs and a college trained pilot can shop both in and out of aviation.

Pentagon planners now are working on legislation that would improve dependent medical care, survivors' benefits, housing conditions and retirement provisions, in an attempt to compete with civilian jobs—mostly on the airlines.

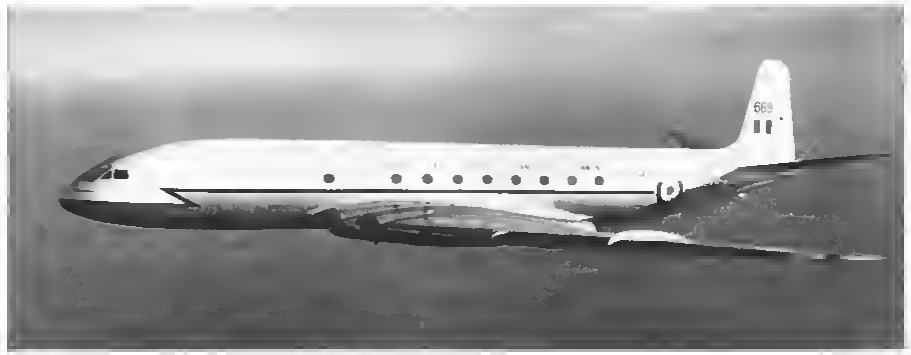
They feel that last year's armed services pay bill takes care of the salary situation, provided flight pay is always retained.

Attempts also are being made to increase the percentage of regular officers in the services. A recent study shows that interest in becoming a regular officer is high.

Still another consideration is where to put military pilots when they become too old to fly. Planners realize that airline jobs offer pilots good security in later years.

Even if all benefits were improved, the military feels it still would have a difficult time competing with a healthy civilian economy, but it is trying.

"If we were able to lick the retention problem, we would cure 99% of our ills," USAF said.



Tronsport Commond's Comet 2

First of the reworked and redesigned de Havilland Comet 2 jet transport is about to be delivered to the RAF Handling Squadron, Boscomb Down, for proving before squadron assignment. First unit of Transport Command to get the Comets will be 216 Squadron at Lyneham. Among obvious changes in the revised Comet 2 layout are the round windows replacing the original rectangular units. Wing fences and duct lips also have been altered slightly. Powerplant is four Rolls-Royce Avon 117 engine turbojets, each rated at 7,300 lb sea level static thrust. Plane will operate with full cabin pressure differential of 8.25 psi.

BOAC Strengthens Bermuda Schedule

British Overseas Airways Corp is making a sustained bid for a greater share of the West Indies-Bermuda travel market, utilizing turboprop Vickers Viscount transports of its subsidiary, British West Indian Airways.

Latest BOAC moves with BWIA's Viscounts include:

• **Inauguration of Saturday** and Monday first class service from New York to Bermuda using three Viscounts with joint BOAC BWIA markings flown by BWIA crews. The service will be expanded with an additional flight on Wednesday beginning January 28. The British airline also expects to increase the fleet to six Viscounts.

• **Plans to increase** its current twice-daily Viscount service using BWIA planes and crews from Miami to Nassau to three daily 40 min flights on January 24th. It inaugurated this service December 16th.

The new Viscount service was started January 2 because of demands for first-class accommodations. New York-Bermuda Viscount fare is $123 round-trip plus 10% tax. Passengers flying through to Barbados or Trinidad, however pay tourist fares all the way: $270 round-trip plus tax to Barbados, $282 round-trip plus tax to Trinidad. The airline reports that most of its Viscount tickets thus far have been sold for through flights.

The Viscounts are making the New York-Bermuda flight in just under three hours, BOAC reports as compared with about 3 5 hours for its Super Connies.

Caravelle to Visit U. S.

New York—A U. S. demonstration and sales tour with the twin-jet S. E. 210 Caravelle is planned later this year by Sncase, French builder of the medium-range airliner. Points of call will include Washington, Philadelphia and, it is hoped, New York.

Question of a New York stop hangs upon obtaining permission for landing and take-off at an airport under jurisdiction of the Port of New York Authority. The authority already has barred the Boeing 707 and de Havilland Comet jetliners on the grounds that the noise factor would increase public pressure for restrictions on aircraft operations in the metropolitan New York area (AW Dec. 26, p. 18).

An alternative to landing at a commercial airport would be to bring the Caravelle in at a military field or at the Republic Aviation Corp. field, Farmingdale, Long Island. Republic has expressed an interest in the possibility of building the French airliner, now powered by two Rolls-Royce RA16 Avon engines, each developing 10,000 lb. static thrust.

Strike-Bound Western Suspends Operations

Los Angeles—Services of Western Air Lines in 12 states and Canada were halted last week as 850 reservation clerks and baggage handlers threw picket lines around the airline's key airport and service installations.

Members of the AFL-CIO Brotherhood of Railway Clerks struck without notice after the National Mediation Board released jurisdiction in the stalemated negotiations.

Key issues in the dispute are demands by the labor organization for a union shop and wage increase.

Western, meanwhile, awaited word from 257 members of the Air Line Pilots Association who earlier had threatened a walkout over demands for increased company contributions to a proposed annuity pension plan.

The National Mediation Board also released ALPA to take whatever action it chose against the airline but in view of the clerks' walkout ALPA spokesmen admitted their picture had changed. When the airline suspended operations, an ALPA official said:

"Our pilots are guaranteed a minimum of 60 hrs. flight time plus base pay or an average of $800 per month per pilot. We expect the company to honor our contract regardless of the suspension order."

A Western spokesman said the pilots would be paid as long as they are not furloughed. "But," he added, "if the planes are not flying, it won't be long before they're on furlough."

The Brotherhood of Railway Clerks, demanded a $50 a month across-the-board wage increase and a union shop. Later it reduced its wage demand to $35. Western countered with an offer of an 8% average increase but rejected the union shop proposal.

Rothschild Pledges Airways Development

A new Administration policy of concentrating on development of a bigger and better airways system has been outlined by Louis S. Rothschild, Under Secretary of Commerce for Transportation.

The Commerce Department will ask Congress for substantially more money to spend on navigation and communications system during Fiscal 1957, Rothschild told a transportation meeting of the U. S. Chamber of Commerce.

Rothschild said that the tremendous expansion of air commerce makes safety, including construction and operation of airways, the major problem now confronting Federal administrators.

We have major improvements in progress," he said. "We have asked for substantially more funds in Fiscal 1957 for radar, modern, static-free communications and other electronic systems to give immediate help to this situation.

"And these funds are to be used to meet a program that has been carefully coordinated as to basic needs with the airline industry and other civil airplane operators as well as with the Army, Navy and Air Force."

According to Rothschild, a program has been developed for integration of air defense radar and the still undeveloped automation type air defense system with the air traffic control system. He said that the air navigation system is being modernized and that good weather procedures for prevention of mid-air collisions are being tried out.

Rothschild said the Administration is asking for money for more air controllers, communicators, engineers and maintenance men in order to keep pace with the rapid growth of air operations.

CAB Extends Surface Mail Rates

Local service airline rates for transportation of surface mail have been extended for a year by the Civil Aeronautics Board.

The Board has decided to defer a final decision on surface mail rates for the local airlines until after final rates are set for the trunk airlines.

Hearings have been held on the trunk rates, and an examiner's report is expected soon.

In its show cause order, the Board said that the outcome of the trunk rate investigations will have a significant bearing on the rate level for surface mail for the local airlines.

The CAB feels that it will be in a much better position to establish the local rate in light of evidence developed in the trunkline cases.

Originally set in December, 1953, the 30 cent per ton-mile local airline rate has been extended twice. The last extension expired Jan. 11.

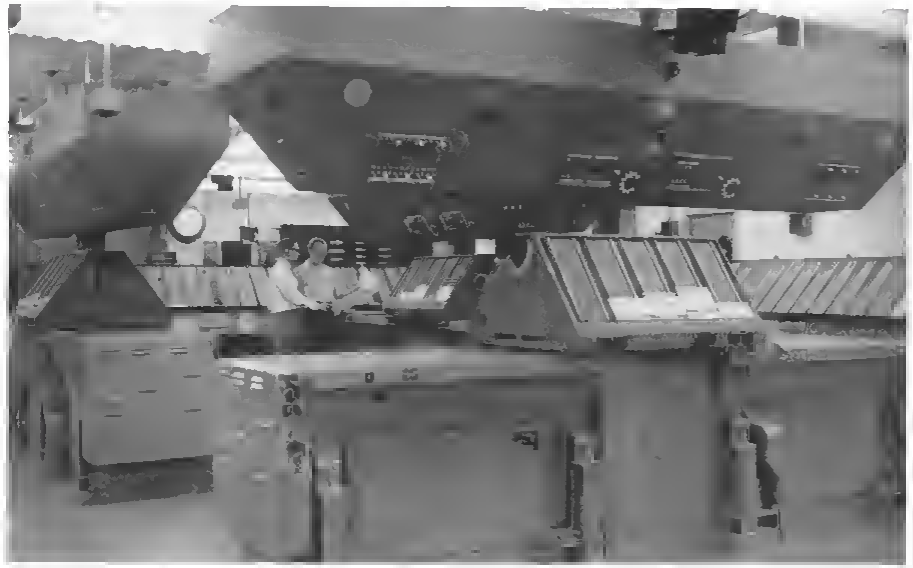
During the year ending Oct. 31, 1955, the local airlines carried 376,771 ton miles of surface mail and made $113,031.

In the total period from Dec. 16, 1953 to Oct. 31, 1955, the carriers operated 562,736 surface mail ton-miles and earned $168,821.

Local Service Airlines' Surface Mail

Dec. 16, 1953 to Oct. 31, 1955

Carrier	Mail Ton Miles	Service Mail Pay
Allegheny	12,718	$ 3,815
Bonanza	12,912	3,374
Central	21,975	6,593
Continental (Pioneer)	80,590	24,177
Frontier	163,304	48,992
Lake Central	2,820	846
Mohawk	10,216	3,065
North Central	106,601	31,980
Ozark	8,351	2,505
Piedmont	41,718	12,515
Southern	13,727	4,118
Southwest	19,451	5,835
Trans-Texas	55,332	16,600
West Coast	13,021	3,906
TOTAL	562,736	$168,821



RADAR CONTROL STATIONS in CAA's new N. Y. traffic center. Horizontal VG-1 radar scopes are linked with General Electric FPS-8 long-range radar. Telephone panels are overhead. Progress boards will hold flight plan data. Installation cost, $1 million.

Radar Will Control N.Y. Traffic in March

ANTENNA for Idlewild's FPS-8 radar.

By Alpheus W. Jessup

New York—One step toward a solution of the New York area's increasingly complex air traffic problem was taken up last week when the Civil Aeronautics Administration shifted its Air Route Traffic Control Center into spacious, modern facilities at Idlewild Airport.

First big step will be the inauguration of radar traffic control over the 70 to 80 mile hub of the New York center's control area "before March 15." The equipment including the presentation scopes are installed, but commissioning of the units awaits final acceptance tests.

The new center's immediate gains will come from more efficient organization and increased communications. The old center at LaGuardia Airport was seriously overcrowded and necessarily inefficient. The Idlewild layout in Hangar 11 provides an arrangement of the 61 manually-operated flight progress boards integrated to facilitate coordination among controllers and to provide sequential clearance of planes in flight. Additional direct communications channels between controllers and pilots are provided.

Until the radar units are in operation, however, the center will function the same as in its old quarters. When the radar goes into operation, it will be the first operational use by a traffic control center, although for some time the CAA's Technical Development and Evaluation Center has been running evaluation tests in conjunction with the Indianapolis Air Route Traffic Control Center.

Basic units in the radar installation are a modified General Electric FPS-8 (Fixed Pulse Surveillance, Model 8) radar and VG-1 radar scopes. The FPS-8 is a U.S. Air Force long-range set which has been diverted to CAA. It has a range of 150 miles or more.

How It Works

Designated Terminal Area Surveillance Radar (TASR) by CAA, the Idlewild unit will be used to cover only the hub area of about 70 miles radius from the New York center. The high concentration of air traffic within that circle is the maximum that can be handled by controllers at the VG-1.

With an airway map projected precisely on the scope controllers will be able to "see" the progress of flights over the airways within the hub.

Here's how traffic will be controlled:

- **All departing and incoming aircraft,** equipped with direct communication facilities to the center, will be issued a radar clearance, unless the pilot specifically requests another type.
- **Pilot will navigate** along his planned flight course as usual, or the controller will vector his aircraft to the 70 miles limit of radar control, or to airport tower control.
- **Controllers** at the horizontal VG-1 scopes will mark the identity of each flight on a plastic tab and will follow the progress of the aircraft blip across the scope until it leaves radar control or lands.
- **Separation of aircraft** under radar control from other aircraft will not be less than five mi., a sharp decrease from the 10 mi. interval required under normal instrument flight rules.
- **When aircraft approach** within five miles of each other, the controller will vector one past the other at the prescribed safe distance.
- **Skeleton progress board** backup will be maintained as a safeguard to a failure of the radar unit. (Plans have been made for an alternate backup radar.)
- **Detailed flight plans** will be posted on a progress board for ready reference at the radar scope position.
- **Aircraft departing** from the ring of radar control will continue on normal IFR or VFR clearances, reporting as prescribed over designated fixes, with these being posted at the flight progress boards in the control center.

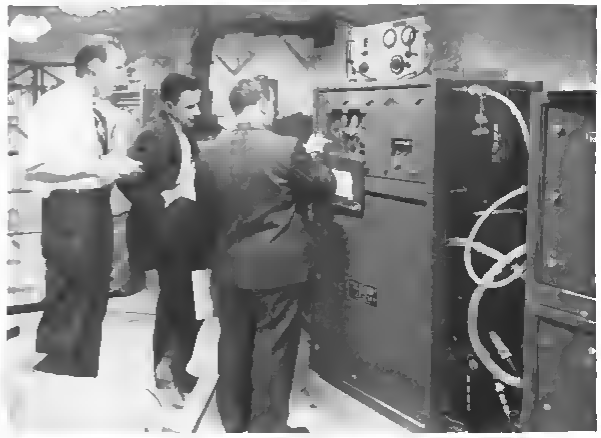
The radar system operating in this fashion is expected to speed up the flow of air traffic into, through and out of the congested New York area with much greater safety.

One advantage is an increase in flexibility of aircraft arrival sequence control provided to the controllers. An example: A DC-7 passing a fix 75 mi. out five min. behind a Convair will arrive at the airport approach fix first but under past procedures will have to wait over the fix until the Convair at a lower altitude has commenced its landing approach, with radar control, the DC-7 can be vectored safely around or through the altitude of the Convair and commence its landing approach ahead of, but without delaying the Convair.

Rain Solutions

Consideration has been given to the problem created by heavy rain blotting out aircraft from the radar beam. The FPS-8 operates on the L-band with a frequency which is considerably less affected by precipitation than the S-band frequencies of short-range tower radar sets. Moving target indicators also are being installed, and the CAA is providing circular polarization kits for the tower radars. Circular polarization has been found a successful cure to precipitation interference.

VERTICAL SCOPE gives controllers at flight progress board visual check of traffic progress.



BEHIND THE SCENES, engineers check FPS-8 radar equipment at traffic control center.

Control area of the New York center runs from Salisbury, Md., west to Harrisburg, north to Elmira and east to Hartford and Montauk Point. It also includes control of an Atlantic Ocean area east to 45 deg. W., and north to 46 deg. N.

The oceanic sector is now under radar control through use of a USAF FPS-8 installation located at Mitchel AFB. Controllers located at Mitchel will be moved to Idlewild.

Space has been provided in the new center for a UHF/VHF direction finder if and when it can be procured. Meanwhile, this station will assist lost aircraft by plotting fixes from direction finding reports received from military DF stations.

As modern as the new center facilities are in comparison with the old LaGuardia setup and other control centers throughout the country, experienced controllers here consider

that is no more than matches current needs They expect that the increased traffic and new aircraft expected to be put in service during the next three years will antiquate this establishment

The New York Air Route Traffic Control Center is the busiest of CAA's 31 centers, handling some 6,000 postings on an average day and 12 000 on peak days of instrument weather

CAA Biggest Job: Break Traffic Snarls

New York—Breaking air traffic bottlenecks is the biggest job facing the Civil Aeronautics Administration, Charles J Lowen said last week in his first public address since becoming the CAA administrator

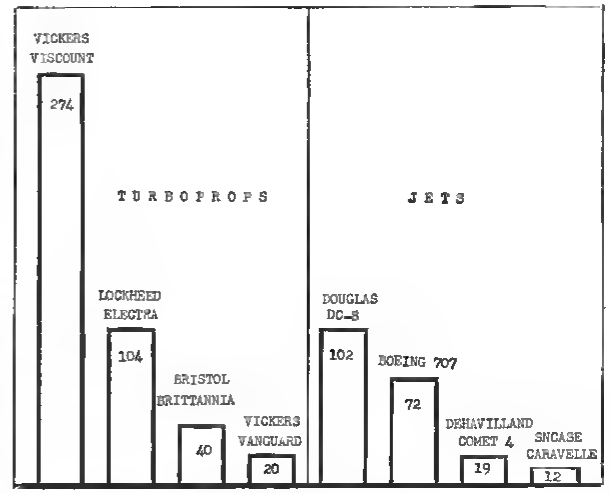
Predicting that the pilot position reports handled by CAA in 1960 would total 29 million (as compared with 20 6 million in 1955), Lowen said the new high speed aircraft further compel us to accelerate the improvement of our air traffic control system He told officials and guests assembled for the opening of the New York Air Route Traffic Control Center that

"We have a choice between limiting traffic to what we can handle safely with today's equipment or of providing our controllers with the means of handling safely all the traffic that an expanding economy is certain to generate.

"In a dynamic country like ours, can anyone doubt for a minute that we much choose the path of growth and progress?"

Other points made by the new CAA administrator

- **Radar is a primary** requirement for keeping the traffic control system geared to the demands of air traffic "We hope that during the next two years we can expand radar coverage so that the heavily traveled routes from Boston to Norfolk, for example will be under a complete radar umbrella."
- **Major initiative** for improving traffic control system and developing new aids must come from within CAA itself "I am not satisfied with the rate of progress in such developments but I must caution that these problems cannot be solved fast " Every major new development must check out as safe and reliable, be acceptable to all users and show a reasonable relationship between cost and ultimate benefit
- **CAA personnel need** new flying equipment with which to keep up to date. "You can't really keep up with the jet age when the hottest aircraft ordinarily available to you is a DC 3 I hope to correct this situation," he said, implying that CAA would soon seek new aircraft for operation tests.



Jet Sales Temperatures Rise

Commercial sales of turboprop air transports now totals 43% with Vickers's Viscount alone in the light-weight class followed by Lockheed's Electra. U S turbojets—Douglas DC-8 and Boeing 707—monopolize the 205 of this class on order

Pilots Blamed in Two Collisions

Washington—Lack of pilot vigilance and failure to follow traffic procedures were the cause of separate collisions involving two DC-3s operated by airlines and two light planes, according to Civil Aeronautics Board accident reports

The reports covered collision of a Trans World Airlines DC 3 with a Cessna 140A at Kansas City and a Continental Air Lines DC 3 with a Piper Tri Pacer at Hobbs, N M

The TWA accident occurred between two aircraft on training flights After making a touch-and-go landing at Fairfax Airport, the TWA DC 3 was making a left climbing turn when it collided with a Baker Flying Service Cessna making a simulated low frequency range approach Both occupants of the light plane were killed

The Board found that the Cessna flight failed to report on its inbound procedure turn and said that it wasn't unreasonable for the traffic controllers to miss visual contact with it But the report said that the controllers didn't carry out their full advisory function, since they didn't tell the DC 3 that the Cessna was making its approach

The CAB report also found that the TWA flight didn't fly in the approved flight pattern, which called for 2,000 ft of altitude before a turn was started By flying the proper pattern, the DC 3 might have passed over the collision area, according to the Board.

Tests made after the accident led the Board to conclude that the pilots of both aircraft had the opportunity to see each other. Despite the attention required in the cockpit during training and check flights, pilots have the responsibility to maintain strict vigilance, according to the CAB, and if such vigilance had been maintained, the accident could have been avoided.

The accident at Lea County Airport, Hobbs, N M., occurred when a Continental Air Lines DC 3 collided with a Hines Flying Service Piper when both aircraft were making their final approach The Piper crashed, seriously injuring the pilot

As in the TWA accident, the Board found that the pilots of both aircraft should have been able to see each other before the collision occurred Lack of sufficient visual alertness by the pilots of both aircraft was the probable cause of the collision, CAB reported.

Violation of local traffic rules by the Piper pilot was also listed as an accident cause The Piper failed to fly the full traffic pattern in its approach

While approaching the field, both aircraft contacted the airport, which is uncontrolled The Continental flight called the Continental ground operator and the Piper called the Civil Aeronautics Administration office, but neither office advised the other of it's communications.

Another B-52 source goes into action

When world conditions indicated the need for more B-52 global jet bombers, the Air Force ordered this vital defense weapon into accelerated production, and named Boeing's Wichita Division as the second source for B-52s.

Above—on schedule—the first B-52 rolls off the Wichita production lines. Earlier, while the Strategic Air Command was converting to B-47s, Boeing-Wichita turned out these six jet bombers at a one-a-day clip. It is currently in its 49th consecutive month of on-schedule production. Now that B-52s are in stepped-up demand, Boeing-Wichita has accomplished the tremendous task of continuing B-47 deliveries, and at the same time tooling up and going into production on the B-52. This feat demonstrates the vast range of the Division's facilities and manpower resources. It adds Wichita-built B-52s to the steady procession being turned out by Boeing's Seattle plant.

The B-52, along with the B-47, rounds out the striking power of the U. S. Air Force. This team of Boeing heavy and medium bombers will be joined later on by still another Boeing, the KC-135 jet tanker.

The design advances that give the B-52 its revolutionary performance required equally revolutionary production methods. The company's manufacturing divisions, as they had in the case of earlier Boeing designs, devised new ways to produce a new kind of aerial weapon—efficiently, in volume, and on schedule.

The B-52 is an intercontinental nuclear weapons carrier, with a gross weight of over 175 tons. It is capable of operating at speeds beyond 650 miles an hour and at altitudes over 10 miles. Its mission: to retaliate against any aggressor, anywhere.

BOEING

Britannias to BOAC

First two Bristol Britannia turboprop transports to be delivered to the British Overseas Airways Corp. are shown above during ceremonies at London Airport. The transports, turned over after the Britannia was awarded its airworthiness certificate by Britain's Aircraft Registration Board (AW Jan. 9, p. 23), will be used over the airline's African routes.

Lockheed Reports $335 Million In Transport Orders During 1955

Burbank, Calif.—Lockheed Aircraft Corp. last week announced that U. S. and foreign airlines ordered $335 million in new transports during 1955—a record commercial backlog that accounted of well over one-fourth of the corporation's total year-end backlog of $1.2 billion.

This new business calls for production of 177 aircraft of four different types for 17 airlines.

Three of the four transport models which sent Lockheed sales soaring were new models announced during 1955, the turboprop Electra, the extra-long-range Super Constellation 1649A and the Super Constellation 1049H cargo plane. Orders for these planes accounted for $261 million of the order.

Electra Best Seller

Since the announcement of the Electra (largest seller of the new transports) last June, Lockheed has logged $185 million in contracts.

Burt C. Monesmith, vice president and general manager of Lockheed's California Division, described the Electra as "a mainstay of jet air transport fleets" which he said, will carry 75% of all air travelers within 10 years because most passenger volume occurs on flights of 200 to 1,800 miles. Such distances, he said, are "ideal" for the high-speed Electra.

Second largest seller of the new transports is the 1649A which brought in $90 million worth of contracts (including one order received in late 1954 but not reported until 1955). This newest of the Super Constellations has a 6,400-mile range and a 156,000 lb. gross takeoff weight.

1049H Led Way

Third in sales popularity is the Super C Constellation with total 1955 orders amounting to $74 million.

First major penetration of the civil cargo plane market was scored at Lockheed through the Super Constellation 1049H.

The company reports that in less than a year after the 1049H's introduction to the airlines it gained first place in the industry with $44 million worth of orders.

Monesmith said that some additional transport orders, represented by letters of intent, are not reflected in statements of actual backlog.

Deliveries of the new planes stretch into 1960. Some model 1049G and 1049H deliveries are scheduled in 1956, others in 1957.

Model 1649As will fly passengers in 1957.

Initial Electras will go into service in 1958.

Lockheed reports that 10 airlines were added to its family of transport operators during the year, making a total of 36 operators, exclusive of the military services.

Braniff Buys 440s

Braniff International Airways last week placed a $4-million order for five Convair Model 440 transports with delivery beginning in November 1956.

In addition to the Braniff order, Convair also received an order for two metropolitans from Alitalia, the Italian international airline, and a contract for two executive versions of the transport from the Royal Australian Air Force.

The airline configurations will accommodate 44 passengers; the executive model, between 15 and 20.

The orders bring to 67 the number of piston-powered Metropolitans on order at Convair and will extend production of the aircraft into the spring of 1957.

In another purchase, Air France announced an $8 million order for four Lockheed Super-G Constellations, also enough to assure the production of the transport into 1957.

The Super Gs, scheduled for delivery in early 1957, mark the airline's eighth purchase of Constellation equipment since 1946.

The order will bring the number of Lockheed aircraft in service or on order by the French line to 53.

Canadian Airline Wins U. S. Operations Approval

Ontario Central Airlines application for a foreign air carrier permit has been approved by the Civil Aeronautics Board and the White House.

The Canadian carrier has been issued a permit to operate between Kenora, Ontario, Canada and points in the United States in an area which includes parts of Wisconsin, Minnesota, North Dakota and South Dakota.

The three-year authority is designed to provide transportation of a casual, occasional or infrequent nature in light aircraft, to be used in emergencies or when scheduled services are inconvenient.

Intercontinental: Biggest of Boeing 707s

Prospective fore and aft loading arrangement for the Boeing 707 320 Intercontinental is shown in this artist's sketch. Ordered by Pan American World Airways, Sabena Belgian World Airlines and Air France (AW Jan. 2, p. 57), this largest of the planned Boeing jetliner series will carry 146 passengers in a tourist-class arrangement or 124 in first class version. Non-stop flight times predicted by Boeing include Tokyo, Japan, to San Francisco, 9 hr. 27 min.; Los Angeles to Copenhagen, Denmark, 10 hr. 38 min.; and New York to Rio de Janeiro, Brazil, 9 hr. 15 min. The Intercontinental will be powered by 4 Pratt & Whitney JT4A-3 engines.

CAB Approves Merger Of 2 Alaska Carriers

Acquisition of Christensen Air Service by Cordova Airlines has been approved by President Eisenhower and the Civil Aeronautics Board. Both are Alaskan carriers.

The merger agreement calls for purchase of Christensen's certificate routes and equipment by Cordova for $50,000.

The two carriers filed the merger agreement in May 1952, and in July 1952, the CAB issued an exemption to Cordova to permit operation of Christensen's service between Anchorage and Seward, Alaska. Cordova has been serving the route as part of its own operation.

Exemption from terms of the Civil Aeronautics Act was asked by the two applicants so that the delay and expense of a hearing on the acquisition could be avoided. The CAB found that a hearing wasn't necessary in the proceeding and issued the exemption.

The CAB has transferred Christensen's certificate to Cordova, but Christensen's authority to operate as an Alaskan Pilot Owner was continued indefinitely. Cordova's authority to suspend service between Cantwell and Denali, Alaska, also was extended.

Prop Reversal Failure Blamed in Accident

Propeller reversal failure caused a Northwest Airlines Stratocruiser accident at Chicago's Midway Airport last August, according to a Civil Aeronautics Board accident report.

The accident occurred when the NWA airplane overran the runway and crashed through a boundary fence. There were no passenger or crew injuries, but the aircraft was seriously damaged.

The CAB found that the probable cause was the inability of the pilot to stop the aircraft when propeller reversing was unavailable due to improper circuit breaker position.

The accident occurred after a flight from Minneapolis/St. Paul to Chicago. Departure from the Twin Cities was made under an IFR flight plan, but the landing at Chicago was made with a 10,000 ft. ceiling with 10 mile visibility.

During the landing roll, the pilot found that propeller reversing was unworkable, and the aircraft's braking system failed to stop it before it reached the end of the runway. The NWA Stratocruiser was turned left to avoid a concrete marker, ran over several hundred feet of grassy area and broke through a chain link boundary fence into a street which bordered the airport.

No injuries occurred, but severe damage to the aircraft included tears in the fuselage from parts of the fence which became entangled in the propellers. Propellers, landing gear, flaps and an engine mount were also damaged.

The Board concludes that improperly set reversing control circuit breakers were the cause of the failure of the propellers to reverse during the landing roll. The Board also found that the 85 degree temperature may have caused some runway slipperiness.

Airline Income and Expenses—October, 1955

	Passenger Revenue	Mail Revenue	Express Revenue	Freight Revenue	Subsidy	Total Operating Revenue	Total Operating Expense	Net Operating Income (before taxes)
DOMESTIC								
American	$20,750,331	$563,651	$473,492	$1,412,256		$23,445,458	$19,119,104	$4,326,354
Braniff	3,313,318	82,896	60,420	90 539		3,665,572	3,027,175	638,397
Capital	4,106 408	92,685	121,958	101 612		4,573,294	4,484,997	88,297
Colonial	606,985	8,090	4,388	15,458	$46,629	694,194	704,244	−10,049
Continental	1,328,446	31,423	12,729	36,912	82,985	1,544,812	1,383,675	161,137
Delta	4,432 117	109,969	112,817	164,552		4,923,504	4,082,551	840,953
Eastern	13,603,671	315 582	232,689	253,562		14 711 062	13,853,552	857,510
National	2,742,683	76,198	25,174	92,752		3,079,472	3,097,319	−17,847
Northeast	637,871	12,382	11,310	18,069	118,738	808,772	802,793	5,979
Northwest	4,099,860	140,509	94,088	166 169		4,573,987	3,868,333	705,654
Trans World	13,116,854	340,255	366,769	502,025		14,563 465	12,771,678	1,791,787
United	18,416,163	650,130	532,248	784,048		20,508,460	17,471,037	3,037,423
Western	2,616,120	78,476	32,582	52,930		2,820,555	2,339,851	480,704
INTERNATIONAL								
American	356,195	14,003	140	51,813		437,715	362,073	75,642
Braniff	398,395	119,127		29,414		584,654	695,980	−111,325
Caribbean Atlantic	69,440	1,310		3,091		80,278	109,630	−29,352
Colonial	89 430	394		1,801	4,603	104,614	110,841	−6,227
Delta	293,009	5,925		16,850		325,101	409 611	−84 510
Eastern	809,023	28,286		18,491		869,139	722,852	146,287
National	266,746	3,511	1,849	11,557		322,191	341,888	−19,697
Northwest	1,066,415	77,278	5,399	238,188		1,405,979	1,893,177	−487,197
Pan American								
Alaska	332,000	16,000		64,000	118,000	618,000	665,000	−47,000
Atlantic	6,439,000	596,000		708 000	314,000	8,501,000	8,192,000	309,000
Pacific	3,871,000	627,000		501,000		5,161,000	4,738,000	423,000
Latin America	4,150,000	68,000		854,000	403 000	6,176,000	6,234,000	−58,000
Panagra	1,143,416	72,738		86 571	62,449	1,537,785	1,484,325	53,460
Trans World	3,966,009	527,251		290,282		5,134,571	5,088,835	45,736
United	982,744	28,911		14,846		1,037,026	807,865	229,161
LOCAL SERVICE								
Allegheny	351,837	7,532	12,481		135,434	419,786	532,189	−14,614
Bonanze	120,210	2,600	1,561	2,853	83,781	225,913	234,135	−8,222
Central	85,017	−5,747	736	3,413	184,276	273,680	262,696	10,983
Frontier	213,615	227,790	3,238	19,712		474,244	467,566	6,678
Lake Central	107,163	6,656	9,097		113,452	237,182	235,306	1,875
Mohawk	364,750	4,779	3,743	5,656	37 500	429,411	453,984	−24,573
North Central	461,266	13,000	14,355		122,163	616,218	603,594	12,624
Ozark	236,567	247,500	6,996			504,882	422,141	82,741
Piedmont	395,091	8,379	5,936	6,744	126,343	560,766	534,732	26,024
Southern	147,340	6,516	6,692		140,944	312,982	320 850	−7,867
Southwest	244,072	5,430	2,839	3,739	82,806	377,830	364,717	13,113
Trans Texas	193,822	9,313	3,175	5,605	203,357	438,044	377,624	60,420
West Coast	175,029	1,552	1,603	2,797	127,093	312,900	329,669	−16,769
HAWAIIAN CARRIERS								
Hawaiian	298,323	2,899		54,546		382,074	428,053	−45,979
Trans Pacific	144,470	758		5,587	4,328	160,181	160,846	−664
CARGO LINES								
Aeroavias Sud Americana				206,405		207,955	185,877	22,077
Flying Tiger				872,784		1,104,821	1,066,261	38,560
Slick						1,029,279	1,052,652	−23,373
Riddle				211,576		338,289	270,922	67,367
HELICOPTER								
N. Y. Airways*								
Los Angeles Airways	3,303	9,099	8,970		70,763	93,103	74,714	18,388
Helicopter Air Service		42,075				42,412	41,349	1,063

* Not available

Compiled by Aviation Week from airline reports to Civil Aeronautics Board.

Eight Crashes Mar Airlines' 1955 Record

Safety record of the U S certificated scheduled airlines in 1955 was marred by eight fatal aircraft crashes during the year

Total fatalities included 159 passengers and 23 crew members.

The airlines 1955 passenger fatality rate increased to 65 per 100 million passenger-miles compared to the all time low of 08 recorded in 1954, according to the Air Transport Assn statistics

ATA reports that in 1955 the scheduled airlines handled 41,871 000 passengers while flying 24,471,242,000 passenger miles in both domestic and international operations. The domestic trunk airlines alone flew an estimated 35 million passengers in excess of 19 billion passenger miles The trunklines' passenger fatality rate was 78 per 100 million passenger-miles as against a rate of 10 in 1954 The scheduled international and territorial air carriers in 1955 had a passenger fatality rate of 04 per 100 million passenger miles with total operations amounting to nearly 6 million passenger flying some 5 billion passenger miles.

ATA reports that as of Dec 31 1955 the local service airlines have a record of 57 months without a passenger fatality; territorial service carriers, 52 months, helicopter operators, 30 months, international and overseas, nine months.

Riddle Expands Route In South, Mid-West

Riddle Airlines will start scheduled, daily cargo service in Jacksonville, Washington, Baltimore, Philadelphia, Boston, Atlanta, Cincinnati, Cleveland, Detroit and Chicago this week as a result of recent route awards by the Civil Aeronautics Board

Service in Richmond Louisville, Indianapolis and Columbus will start Mar 1

IATA Schedules Forty Meetings During 1956

International Air Transport Assn has scheduled more than 40 meetings for this year aimed at streamlining agreements which knit routes of its 74 member lines into a worldwide transportation network

They range from small working parties to assemblies of several hundred Many deal with European-Mediterranean problems IATA estimates member airlines will invest 300,000 expert man hours in these meetings during 1956.

Government Contract Awards Announced

North American Aviation has been awarded a $4 million Air Force contract for production of F-86L Sabres, spare parts, special tools and ground handling equipment, Commerce Department reported in a procurement synopsis.

Other major aviation contracts include:

- **Lear, Inc.**, Grand Rapids, Mich., has been awarded a $5,263,464 contract by the Navy Bureau of Aeronautics for vertical gyro indicators, controls, gyros and shock mount racks.
- **Douglas Aircraft Co.**, Long Beach, Calif., was awarded a $940,000 Air Force contract for procurement of C-133A mobile training unit, fabrication and assembly of a C-133A nose section for trainer flight simulator and to perform flight tests.

BuAer also asked for bids on services and materials to perform complete progressive maintenance on 37 R7V Super Constellations. This includes engine changes, potting of electrical connectors, descaling and resealing fuel tanks and backfitting of aircraft service changes.

CAB Orders

(Dec. 29-Jan. 4)

GRANTED

Trans Texas Airways on exemption from provisions of its certificate requiring the carrier to serve Fort Worth on all flights serving Dallas on segments six and seven, until Feb. 29, 1956.

APPROVED

Interlocking relationships between Frank C. LaGrange and Alaska Airlines, the Reading Co., Central Railroad Co. of New Jersey and the New York and Long Branch Railroad Co.

Agreements involving Trans World Airlines, Mohawk Airlines and various other carriers relating to intercarrier arrangements.

ORDERED

Authorization extended 30 days beginning Jan. 5 for Caribbean Air Transport Assn. to engage in discussion informally and with Pan American World Airways relating to action on stabilization of cargo rates between Florida and Central American points. Original authority expired Oct. 31, 1955, but recent developments indicate further discussion may be successful, according to Pan American and CATA.

Lake Central Airlines mail rate, set at the rate proposed by the Board in its show cause order for the period starting May 2, 1955.

Lake Central Airlines and North Central Airlines' applications for service between

Lima, Ohio, and Detroit set down for immediate procedural action.

Trans World Airlines' application for Albuquerque-Tucson service eliminated from the Tucson service case. Frontier Airlines' petition for reconsideration in the case is denied.

DENIED

Applications for exemption authority for air service between Minneapolis-St. Paul and the Quad Cities of Moline/East Moline/Rock Island/Davenport filed by North Central Airlines, Ozark Airlines, Davenport and Cedar Rapids, Iowa; Springfield, Moline and Peoria, Ill.

Shortlines

▶ **Eastern Airlines** reports a record December with 579,800 passengers boarded, compare with 514,520 in December 1954.

▶ **KLM Royal Dutch Airlines** will operate three flights a day between New York and Europe next summer, including two tourist and one first class schedule.

▶ **Kuwait** has signed an agreement with the British Ministry of Transport and Civil Aviation covering operation of communication and navigation services at Kuwait Airport by International Aerodia Ltd. Kuwait Airport is operated by the British agency under an agreement with the local government.

▶ **Linee Aeree Italiane** plans to inaugurate a Vienna-Venice-Rome schedule early this year under provisions of a recently-concluded Air Agreement between Austria and Italy. LAI also hopes to begin a six-flights-a-week service between Milan and Vienna, via Munich, in the spring.

▶ **Pacific Western Airlines** has been refused authority to operate a cross country coach service by the Canadian Air Transport Board. The carrier wanted to operate a low-cost, no-reservation service across Canada which would compete with Trans-Canada Air Lines.

▶ **Pan American World Airways** will start service to American Samoa from Honolulu and the West Coast Jan. 24. The service will be via a monthly DC-4 connecting flight at Nandi in the Fiji Islands.

▶ **United Air Lines** flew 293,087,000 passenger-miles in December, 4% more than in December 1954. Express traffic was 1,273,000 ton-miles, up 14%; mail was 3,271,000 ton-miles, up about 1%; and freight totaled 2,650,000 ton-miles, a 22% decrease.

EMPLOYMENT OPPORTUNITIES

NATIONAL COVERAGE

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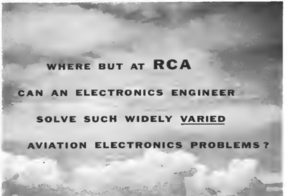

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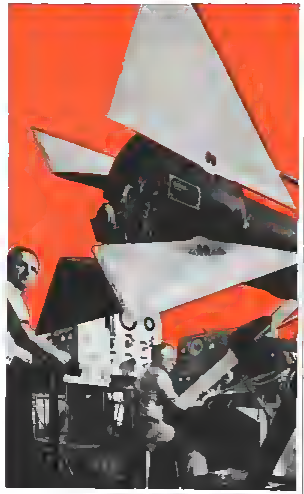

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Inertial Guidance

We read with interest your article in the January second issue of AVIATION WEEK entitled "Inertial Navigation Out of the Laboratory into Missile Systems."

Because there is very little unclassified information printed on this subject, we would like to know if you are planning to reproduce this series of articles on inertial navigation. The first article is a good introduction to the subject, especially for acquainting engineers with inertial navigation who know very little about the field. Would you let us know whether or not it would be possible for us to obtain copies of this series of articles or if not would it be possible for us to reproduce them giving credit to AVIATION WEEK as the source.

MARTIN M. PHILLIPS
Director of Personnel and Engineering Services
Massachusetts Institute of Technology
Department of Aeronautical Engineering
Cambridge 39, Massachusetts

(The inertial guidance series will be reprinted by Aviation Week. Single copies will be available in about four weeks to Aviation Week subscribers upon request without charge. Other copies will be billed at the following rates: One to 10 copies, 40¢ each. 11 to 100 copies 30¢, over 100, 20¢. Orders for reprints should be addressed to Aviation Week, 330 West 42 Street, New York 36, N. Y.—Ed.)

On Airport Financing

Mr. Herb Singer's letter in AVIATION WEEK January 2, 1956 raised a very pertinent question. If the cities of the United States had adopted as a matter of operating philosophy that the airport terminal buildings should be constructed, maintained and operated solely through tax moneys, then Mr. Singer's questioning of the propriety of using public property to further private interests would be wholly correct.

The more progressive city administrations have tried to establish their airports on a business operating basis consequently these administrations are attempting to make the airport a financially self-sufficient unit of municipal government. This self-sufficiency is extended in some cities to the point of recompense of the tax payers original investment through adequate user rates and charges and the maximizing of all airport revenue potentials.

If the airport costs are to be borne only by aviation users then the burden on this still young dynamic industry would be very oppressive. It is only through the development of such ancillary revenue sources for example, advertising, cocktail lounges and paid parking that cities are able to approach a financially break even operation without unduly burdening the aviation users of the airport. Mr. Singer's genuine interest in the philosophy of the operation of airports is very fine. If more of our traveling and non-traveling public would take a similar interest in their own airports, much could be done in the improvement of the quality of service facilities and operation of this very important unit of city government.

JOHN F. BROWN
Landrum and Brown
111 East Fourth Street
Cincinnati 2, Ohio

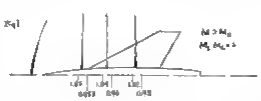
Area Rule Potential

Referring to Mr. E. Lagelbauer's publication (on the area rule concept) in AVIATION WEEK 24 October 1955 p. 81-83, I should like to contribute the following.

Firstly: "Wave producing contours". It should be clear that it is just the cross sectional area enclosed by its corresponding contour that is more or less wave producing.

Secondly: Under "Lessening the shock" Mr. E. L. refers to nothing else than to Busemann's shock polar (Sauer "Theoretical Introduction Into Gasdynamics" or Miles "Supersonic Aerodynamics") which is in no direct relation to the "Area Rule".

The area rule deals with a sonic interference problem. With a convex contour at flight Mach number $M_\infty = 1$ a blockage occurs, presumably due to the fact that the displaced air determined by the cross-sectional areas is successively accelerated and decelerated at each of some successive local shocks and Mach numbers. This may be shown in fig. 1.

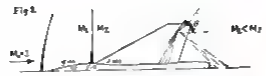


Further we remember an important definition of the Mach number:

$$M^2 = \frac{\text{Kinetic energy of fluid mass motion}}{\text{Kinetic energy of random molecular (thermal) motion}}$$

Herefrom results that the flow surrounding the body flying at $M_\infty = 1$ is an oscillating flow with a locally variable mass. Thus the flow is blocked up and a high interference wave drag arises from the asymmetric pressure distribution generated by the straight shock wave system.

Now a contraction of the fuselage—or even also airfoil cross-sectional area at the body wing joint, produces local Mach numbers beyond 1 allowing for an undisturbed flow with minimum interference drag in that region. This is shown in fig. 2.



The change of contour slope at the front part from positive to negative requires that the flow continues accelerating. At the stern part where the slope becomes positive again an oblique shock wave is built up at the intersection of the Mach lines. This shock wave should be located sufficiently far away from the contour which in turn should not extend too far backwards in order to prevent the new disturbances from reaching again the contour.

When the fuselage shape is to be determined consideration should be given to the boundary layer thickening. The boundary layer thickness should be subtracted from the contour ordinates at the body wing joint as much found by the area law.

Thirdly: Regarding Mr. E. L.'s sketch "THE ONLY PATH ALONG WHICH A DISTURBANCE CAN TRAVEL WITH THE SPEED OF SOUND AND UNTIL INFINITY IS ON THE SURFACE OF THE MACH CONE FORMING THE APEX ANGLE

$$\sin \mu = \frac{1}{M_\infty}$$

Assuming that in point "A" on the wing surface disturbances are generated at $M_\infty = 1$ it is herefrom evident that then only path lies in the plane perpendicular to the airplane's plane of symmetry through point "A" i.e. "AB" in the sketch. For $M_\infty > 1$ it becomes increasingly smaller and for the design Mach number ($\alpha > 0$) the disturbances generated at "A" must not touch the fuselage anymore.

Agreeing with Mr. Lagelbauer it should be studied whether the coke bottle configuration for $M_\infty = 1$ should be applied for supersonic airplanes flying at say $M_\infty = 2$. Surpassing the $M_\infty = 1$ zone takes a few seconds only. The optimum fuselage shape for $M_\infty = 2$ differs from that for $M_\infty = 1$, the latter one producing more wave drag at $M_\infty = 2$. Considering further that Drag $\sim M^2$ it is roughly can illustrate the facts in fig. 4.

Therefore the final solution for the shape of a supersonic airplane is a compromise case.

KARL L. SANDERS
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